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Europe Report

SCIENCE AND TECHNOLOGY

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28 MAY 1986

EUROPE REPORT

SCIENCE AND TECHNOLOGY

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WEST EUROPE/ADVANCED MATERIALS

RESEARCH ON VACUUM PROCESSING OF SUPERCONDUCTORS

Bologna VUOTO in Italian Oct-Dec 85 pp 243-250

[Article by E. Olzi, CNR-ITM, Via Induno 10 - 20092 Cinisello Balsamo: "Influence of Vacuum Technology in the Processing of Superconductive Materials"; labeled in English as: "Invited paper presented at the 9th National Congress on Vacuum Science and Technology, [of the] AIV [Italian Vacuum Science and Technology Association], Florence, 7-10 October, 1985"]

[Text] Summary: This paper discusses three practical cases of the manufacture of metallic materials used in the field of superconductivity. In all the cases considered, it is found that vacuum science and technology, combined with knowledge of thermodynamics, can resolve otherwise unresolvable problems and render possible the production of such materials.

1. Introduction

As is well known, superconductive materials are characterized by the fact that, at temperatures near absolute zero, they lose their electrical resistance.(1)

According to the well-known BCS Theory(2), this is owing to the fact that at such temperatures the electrons tend to bind together in pairs (known as Cooper pairs); such pairs, when set in motion by an electrical field, acquire a net momentum that, unlike that of single electrons, cannot be reduced by scattering, inasmuch as the energy required for the scattering of a pair is far greater than that which binds the electrons together in the pair. In addition, quantum mechanics tells us that the minimum-energy state is reached at the point where all the pairs possess the same momentum, and thus a variation in the momentum of one pair would entail a variation in the momentum of all the pairs. The result is therefore that the lattice, by means of its own vibrational energy, which is low at low temperatures, is unable to redistribute the momentum of the pairs and hence to create electrical resistance.

A very large number of pure metals become superconductors at temperatures close to absolute zero. This property, however, is extinguished by the presence of even a weak magnetic field.

Abrikosov[3] has explained why some materials lose their superconductive properties in the presence of external magnetic fields and others do not. According to this theory, there are two types of superconductive materials: Those of the first type, which lose their superconductive properties in the presence of even very weak magnetic fields, and those of the second type, which can withstand very strong magnetic fields without losing those properties. Some types of alloys and intermetallic compounds belong to the latter family.

This brief preamble has been inserted to explain that the choice of materials for the production of superconductive fibers and cables is made on the basis of precise physical criteria. These criteria impose the use of several types of materials: The most widely used is undoubtedly Nb-Ti alloy in the form of fibers of very few μ in diameter and embedded in a copper matrix. Other very important materials are Type A-15 intermetallic compounds (such as Nb_3Sn, Nb_3Al, Nb_3Ge, V_3Ga, etc); new materials are emerging as of recent date, such as, for example, Chevrel phases and the C-15 compounds (Laves phases). Be it noted forthwith that, insofar as concerns the ductile alloys (such as Nb-Ti), they are relatively easy to produce and to use, given their excellent mechanical properties, even though the upper limit of field attainable in practice with windings of these materials generally does not exceed 8 teslas. On the other hand, fields of much higher density are attainable with windings of intermetallic compounds, although their extreme fragility makes their use problematical.

From a purely metallurgical standpoint, it is noted that the metals most frequently used for the technological manufacture of superconductor cables belong to the 4th and 5th principal groups of the Periodic Table; these are, namely, Ti, Zr, Hf, V, Nb and Ta. These materials, however, as is well known, are among the most reactive with respect to the gases in general and oxygen in particular; and the product of the reaction invariably results in highly stable oxides. For these reasons a knowledge of the metallo-gas system and of the kinetics of oxidation of these elements is a fundamental prerequisite to the undertaking of experimental work on or the production of superconductive fibers; it follows, then, that the use of vacuum technology in the heat treatment of superconductive materials is indispensable and unsubstitutable.

This paper will examine a few cases in which knowledge of the behavior of these metals in the presence of gases, and obviously the use of vacuum processing techniques, makes possible the manufacturing of products in general and of superconductive fibers in particular.

2. Nb-Zr Alloys

These alloys are used as structural materials for high-temperature applications and in the field of superconductivity.

Table 1

Summary of Experimental Results of Degassing of Samples Containing Initially 1.2at%O - Oxygen Content in at%.

(1) Temperatura °C	(2) Tempo (min)						
	2	4	6	7	10	15	30
2100	0,89	0,77			0,20		tr.
2000		1,14	0,90	0,83	0,87	0,56	
1900		1,18			1,10		

Key:

1. Temperature in °C.
2. Time in minutes.

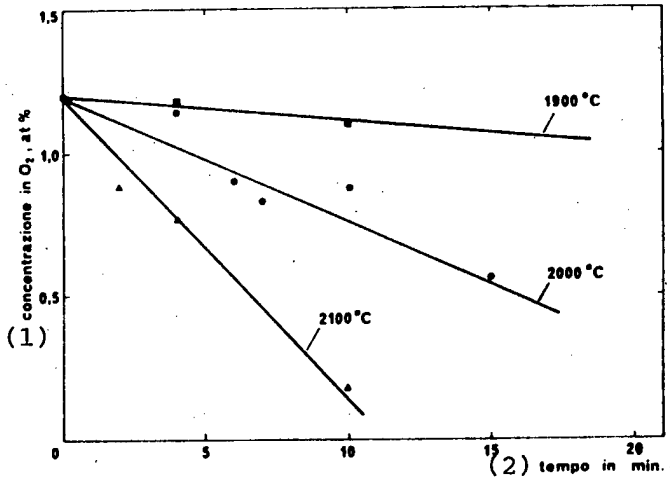

Fig 2 - Decrease of oxygen content at various temperatures during degassing process.

Key:

1. O_2 content in at%.
2. Time in minutes.

During the 1970's[4], our Institute was given the task of processing Nb-Zr alloy tapes to be used as supports for the superconductive intermetallic compound Nb_3Sn. A study was immediately initiated on the parameters of practical use of this alloy, one of which was the possibility of degassing its oxygen content. The alloy Nb-5at%Zr was examined.

The initial ingot was obtained by melting in an electron beam furnace, with which the Institute is equipped; and wires 1 mm in diameter were obtained by means of cold swaging. All samples were first reheated and recrystallized in a vacuum better than 6×10^{-4} Pa for 5 minutes, then gassed at 1,400°C for 10 minutes at a partial oxygen pressure of 1.16×10^{-2} Pa. Under these conditions, the calculated oxygen concentration for the pure niobium should have been approximately 1at%. A few moments after the start of degassing, small particles of oxide (ZrO_2) were observed forming on the surface of the samples. A micrographic examination of the cross section of the samples (Fig 1 [not reproduced here]) showed the presence of a gray ring, near the surface, consisting of precipitates of ZrO_2. The samples thus oxidized were then treated at temperatures ranging between 1,900°C and 2,100°C in a vacuum better than 6×10^{-4}Pa for various times, to determine whether the degassing of such contaminated alloys was possible. The values of oxygen concentration following the degassing treatment for different times and temperatures are shown in Table 1. As can be seen, the residual oxygen content diminishes as heat treatment time is increased at a given temperature; also, for a given duration of treatment, the residual oxygen content diminishes as heat-treatment temperatures are increased.

These results are diagrammed with respect to time in Fig 2, from which it can be seen that the curve of the experimental points can be represented by straight lines. A new micrographic examination of the cross section of the samples after partial degassing (Fig 3 [not reproduced here]), showed the partial disappearance of the ring seen in Fig 1.

The foregoing necessarily leads to the conclusion that the degassing of alloy Nb-Zr is possible with heat treatment in a vacuum at very high temperatures. On the other hand, the degassing process observed experimentally cannot be attributed to evaporation of ZrO_2 or to the elimination of gaseous oxygen; actually, the ZrO_2 vapor tension at 2,000°C is of the order of 10^{-26} Pa, and thermodynamic calculations indicate that the ZrO_2 dissociation pressure at the same temperature is less than 10^{-10} Pa of O_2.[5] However, studies of degassing of solid solution Nb-O have shown that the elimination of oxygen occurs through evaporation of volatile oxides NbO and NbO_2.[6 thru 8] The vapor tension of a solid solution of these oxides containing 1at%O at 2,000°C is found to be around 10^{-1} Pa.[9] This evaporation of volatile oxides takes place also in Nb-Zr alloys rich in niobium and containing oxygen. It is responsible for the decrease of oxygen content in the matrix, and the oxygen activity of the matrix is therefore lowered below the value corresponding to the oxygen content in ZrO_2, in accordance with the following solubilization reaction:

$$[ZrO_2] = [Zr]_{Nb} + 2[O] \ .$$

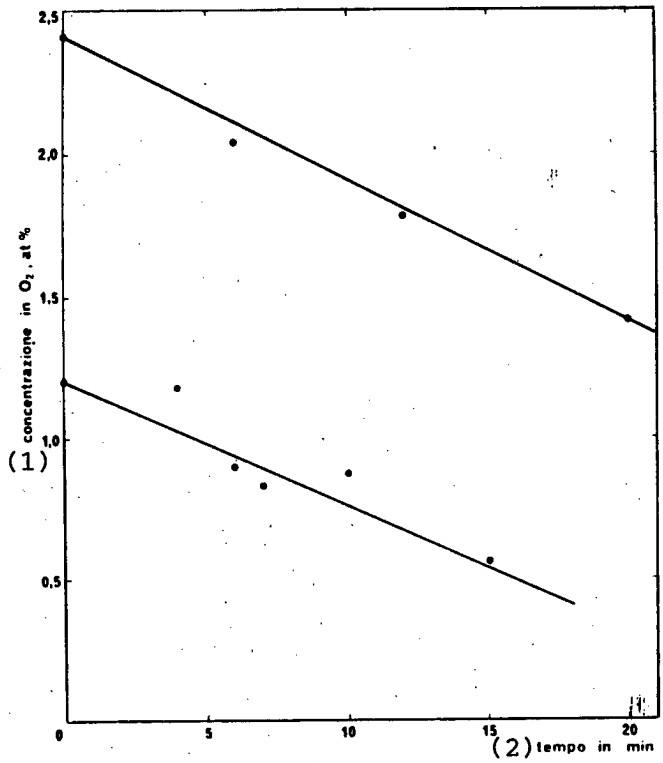

Fig 4 - Decrease in oxygen content during degassing treatment at 2,000°C of samples containing initially 1.2at%O and 2.4at%O.

Key:

1. O_2 content in at%.
2. Time in minutes.

Because of the further removal of oxygen through evaporation of the suboxides of niobium, the activity of the oxygen is continually lowered, and the ZrO_2 is therefore gradually solubilized and the alloy gradually degassed through evaporation of the volatile oxides of the niobium.

As regards the kinetics, it can be assumed that the evaporation of the volatile oxides is the rate-determining process in thin samples (thinner than 1 mm), and that the processes of solubilization of ZrO_2 and diffusion of oxygen take place much more rapidly and may thus be disregarded in the overall kinetics. This assumption was made on the basis of similar processes already observed in the degassing of the Nb-O system.(6 thru 8) Further confirmation of the foregoing can be had from observation of the degassing of samples containing larger quantities of oxygen. The decrease of the residual oxygen in these cases follows a curve almost parallel to the one already observed, as can be seen in Fig 4 which shows the curve of the process at 2,000°C as a function of duration of the heat treatment for samples containing initially 1.2at%O and 2.4at%O.

In conclusion, therefore, through a thermodynamic process that we can define to its limit of feasibility, it has been possible to resolve, by means of vacuum technology, the problem of degassing an Nb-Zr alloy.

3. Nb-Ti Alloys

Nb-Ti alloys with mass concentrations of around 50 percent find use in the field of superconductivity.

The commercially most widely used superconductive cables consist of a large number of Nb-Ti alloy fibers, in diameters of around 40μ, embedded in a copper matrix. Fig 5 [not reproduced here] shows a cross section of such a cable. For reasons having to do with their use, there has been a recent shift in trend towards the production of cables with fibers of diameters under 10μ.

In the manufacture of superconductive cables, the process that more than any other involves the use of vacuum technology is that of melting; in fact, during the mechanical processing of the fibers to reduce their diameter (lamination, drawing, etc), the Nb-Ti alloy is protected by its copper matrix, and consequently all heat processes (heat treatments for optimization) require only the usual protective atmospheres commonly used for the manufacture of conventional electrical cables.

During melting, however, the risk of contaminating the alloy with gas is very high, and vacuum-type melting furnaces must therefore be used. In addition, the reactivity of the alloy in the molten state, with ceramic materials, precludes the use of refractory crucibles, thus necessitating the use of water-cooled copper crucibles.

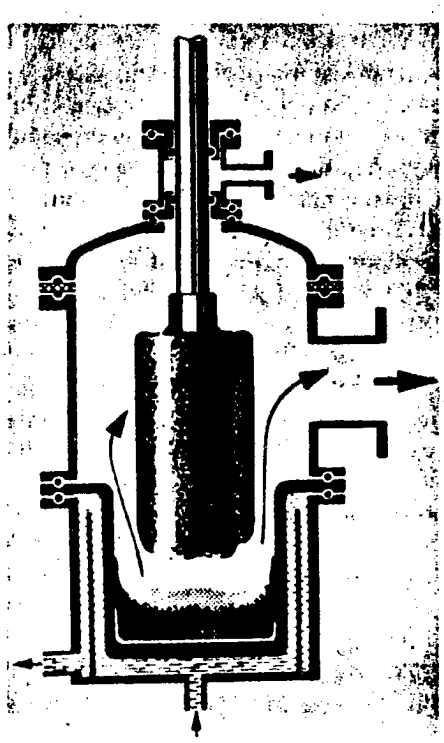

Fig 6 - Schematic functional flowchart of a consumable-electrode arc furnace.

The furnaces commonly used industrially are of the arc and electron beam types.

Electric-arc melting presents no major operative difficulties, except for the preparation of the conductive electrode to be melted. The process takes place in a rarefied atmosphere of noble gas; hence, the evaporation of the titanium (the more volatile element of the two) is kinetically minimized. In this case, however, and for the same reason, the alloy is not purified of its interstitial O and N; in fact, its contamination is possible.

The purity of the alloy can be improved by melting in an electron beam furnace, which must be done, however, in a hard vacuum (in the field of 10^{-3} Pa). In this case, however, problems arise owing to evaporation of the titanium during the melting process. This therefore requires experimental determination of the extent of the evaporation and prior compensation for it in the form of starting dosage. It is also important to note that the melting cycle must be predetermined and cannot be changed for any reason whatever: If, for example, it were found desirable, for reasons of homogeneity, to carry out a further melting cycle that had not been provided for at the start, the titanium content would drop below its planned level and the alloy would become unusable. It follows from this that the recovery of scraps from the melting process, through electron-beam remelting, is precluded unless the evaporated titanium is compensated for; and the latter requires a successive homogenizing remelting. In actual practice, the alloy must be remade.

3.1. Melting Facilities

First of all, let us review rapidly the functional flowchart of a vacuum arc furnace (VAR). The theory is well known[10] and we will therefore not dwell on a review of it here; on the other hand, it will be useful to schematize the configuration of an industrial consumable-electrode, cooled-crucible, vacuum-type arc furnace (Fig 6).

The melting chamber consists of a metallic housing, general double-walled with circulation of cooling water; the copper crucible, also water-cooled, is inserted at the bottom; and a sleeve in which the shank of the consumable electrode can slide is located at the top. The crucible and the electrode are both connected to a suitable direct-current power supply. The assembly is connected to a vacuum pump system and, during melting, can be immersed in a rarefied atmosphere of inert gas. The electric arc, consisting of a field of ionized elementary particles, intensely hot and through which a high current passes, heats the electrode to its melting point, and the melted mass falls into the crucible below containing the alloy already formed and molten at its surface. The ingots thus obtained must be remelted several times to obtain the necessary homogenization of the alloy produced. The initial electrode must be made up of the components of the alloy in longitudinally constant concentration (composite

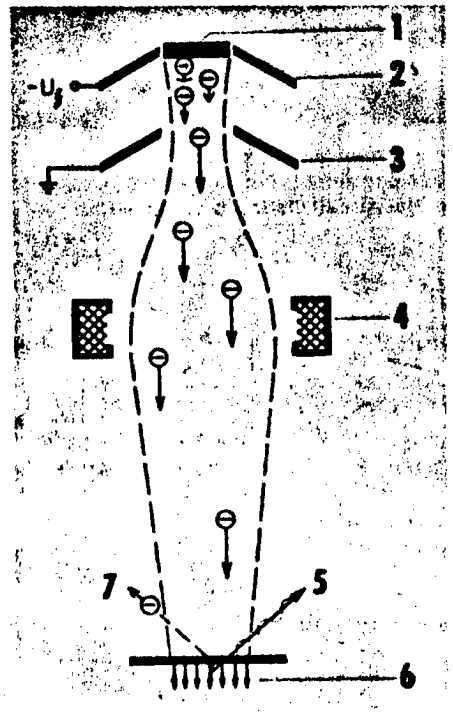

Fig 7 - Operating principle of electron beam furnace.

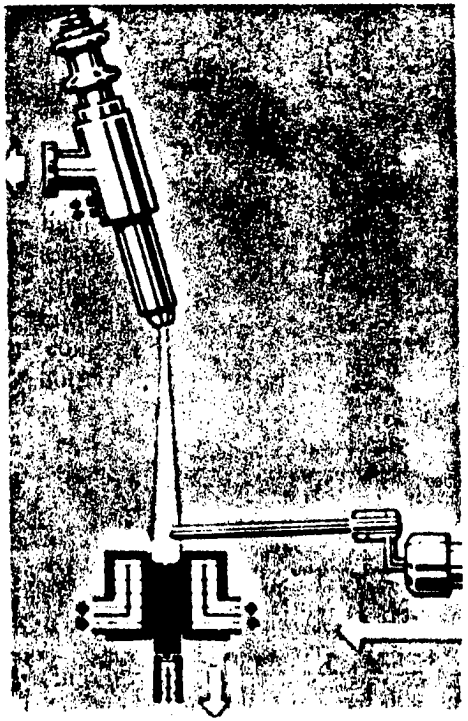

Fig 8 - Functional schematic of an electron beam furnace of the single-gun, horizontal-electrode, retractable-base-crucible type; illustrated is a particular type of drip-melting technique.

electrode). Since this electrode must carry the high melting-current, it must be priorly and properly welded throughout its components. As has been stated, evaporation of the titanium under these conditions is stringently contained owing to the kinetics of slow evaporation in the presence of the rarefied atmosphere.

In the electron beam melting process, the material is brought to its melting point by bombarding it with accelerated electrons. The electrons are generated by a thermionic electron emitter, accelerated by an electrical field, and focused by an electromagnetic lens (Fig 7). Obviously, the optical path of the electrons from the emitter to the target must be devoid of air to prevent deviation, hence scattering, of the electrons by the molecules of air. The electron beam furnace used by us consists of a single gun that bombards an electrode positioned perpendicularly to the path of the electrons, above the crucible (Fig 8). Growth of the ingot is produced by the falling of molten drops into the crucible and the simultaneous, gradual lowering of the ingot as it forms: This technique is called "drip melting." When the operation is performed in a vacuum, there is normally extensive evaporation of the molten material, and the vapors are deposited on the cooled walls of the melting chamber. This results in a better quality of alloy produced from the standpoint of purity, but also in an impoverishment of the titanium content. It should be noted that our equipment is not the best-suited to the operation to be performed, given the formation of shadow zones on the surface of the molten mass; but it is the only one we have.

3.2. Preparation of the Nb-Ti Alloy by Electron Beam Melting

Based on preliminary tests made to determine the extent of titanium evaporation under practical conditions, a calculation was made of the excess of this metal to be introduced into the charging of the furnace for a program involving two meltings (one pre-alloying and one homogenizing) using the drip-melting technique. The electrodes were prepared from round bars of niobium and titanium drawn to the required diameters. It was calculated that, to obtain an alloy having a concentration of 47 percent titanium by mass, the initial charge must be made up of 12 niobium bars, each 2 mm in diameter, and 3 bars of titanium, each 6 mm in diameter.

These bars, all 310 mm long, were assembled in a bundled configuration (Fig 9 [not reproduced here]) especially designed to minimize titanium losses. To this end, the element with the highest melting point--namely, the titanium--was positioned so as to be the first to be struck by the electron beam in such a manner as to form a drop of molten material in which pre-homogenization could take place prior to its falling into the 25-mm diameter crucible. A microprobe spectrometric analysis of the longitudinal section of a "congealed" drop prior to its fall into the crucible (Fig 10 [not reproduced here]) showed that, with this electrode geometry, the homogeneity already present in the drop was satisfactory. This melting

technique thus produced an electrode ingot 25 mm in diameter and 300 mm long ready for homogenizing remelting in a crucible 40 mm in diameter. Fig 11 [not reproduced here] shows one phase in the homogenizing remelting process. The ingot thus obtained presents a surface aspect typical of the product of continuous casting in a cold crucible; in particular, its lateral surface presents roughnesses owing to solidification against a cold wall, and its internal structure is dendritic. Therefore, prior to its plastic deformation to produce fibers, the outer layer must be removed by machining, after which it must be subjected to cold plastic pre-deformation and a recrystallizing heat treatment. It is from thusly processed ingots that, with suitable mechanical treatment, the fibers depicted in Fig 5 can be obtained.

4. Type C-15 Intermetallic Compounds (Laves Phases)

The case considered here is that of production of superconductive fibers from Phase V_2(Hf, Zr), a study recently undertaken by our Institute. The aim of this research was to study the feasibility of producing vanadium-matrix composites containing Hf-Zr alloy fibers, that could be heat-treated to produce diffusion and reaction so as to obtain a layer of superconductive V_2(Hf, Zr) material at the V/alloy interface.

A description of the method used to produce these composites will be presented in another paper; here we shall deal briefly with the aspect which, during our study, created the major problems--namely, the reactivity of the hafnium and the zirconium with oxygen and the consequent need to work in a vacuum.

The Hf-Zr alloy was produced in an electron beam furnace under conditions similar to those described for the Nb-Ti alloy, although on a reduced scale. Despite the use of a harder vacuum than 10^{-3} Pa, the surface of the ingot produced was oxidized; probably, during cooling and despite the vacuum, the reactivity of the elements was too high under those operative conditions.

In any case, the major problems emerged during the heat treatment for diffusion and reaction. Fig 12 [not reproduced here] shows the cross section of a strand made of Hf-Zr alloy embedded in vanadium after 100, 150 and 200 hours of treatment in a diffusion vacuum at 900°C; a microprobe spectrometric analysis showed the gray areas to consist of oxides of Zr and Hf.

Fig 13 [not reproduced here] shows the aspect, as revealed by a scanning electron microscope, of the interface layer of another sample treated for 100 hours under the same conditions. Fig 14 [not reproduced here] shows still another sample which, prior to heat treatment for diffusion and reaction, was wrapped in a protective sheet of Nb; in this case, the superconductive V_2(Hf, Zr) layer is clearly evident and relatively thick. The

magnetic-field critical current tests made on all samples showed that only the sample treated under the conditions of that shown in Fig 14 has a high magnetic-field critical current.

Let us now consider interpreting the observed phenomena.

During heat treatment of "nude" samples, the oxygen content of the residual atmosphere of the furnace was captured by the vanadium and diffused in it; the vanadium, however, contained in its interior a formidable "getter" for the oxygen--namely, the Hf-Zr alloy--which immediately captured the oxygen from the vanadium, oxidizing superficially initially, and then in bulk.

The superficial oxidation constituted an anti-diffusion barrier, preventing the diffusion process, hence the consequent reaction, from taking place. The niobium wrapping of the sample prior to heat treatment, on the other hand, operated as an anti-oxidation barrier for the composite, both because of the reduced mean free path of the oxygen atoms penetrating into the wrapping, and because of the niobium's reactivity with the oxygen. Thus, oxidation did not take place (or did so to a minor extent) and the superconductive intermetallic layer was able to form, as proven by the magnetic-field critical current tests.

5. Conclusions

The three cases discussed have demonstrated the effect of vacuum techniques in the processing of the metals involved. A knowledge of thermodynamics and of the kinetics of the various reactions between gases and metals is undoubtedly fundamental to the undertaking of research in these sectors; vacuum technology, however, remains the fundamental and absolutely necessary basis.

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ITALIAN ADVANCED MATERIALS INDUSTRY, RESEARCH PROFILED

Milan SUCCESSO in Italian No 3, Mar 86 pp 54-64

[Article by Paola Capudi: "New Materials: A Glance Into The Future"]

[Excerpts] Tomorrow's materials, lighter and stronger (and, in the long run, cheaper), are used increasingly in a large number of industrial sectors. Whoever is the first to use them gains indisputable advantages over the competition, improves the quality and competitiveness of his products and keeps abreast of the times. Small- and medium-sized businesses cannot afford to be left at the starting post in this race toward change, since their very future is at stake.

Italy's Awakening

A manufacturer of mass materials but almost nonexistent in semi-finished quality products, Italy risks falling into the category of developing countries at a moment when production with the highest added value and the highest technological content is becoming the mark of leading industrialized countries.

Italy has only recently woken up to the strategic importance of new materials. For decades now, the research departments of state-controlled companies have been in a state of neglect and universities have, on the whole, lost contact with industrial reality: There are only two university chairs in materials science and not one in materials engineering.

In the last few months, the state-controlled companies (which have greater financial resources and operate in sectors which are in the center of industry, such as defense, aerospace, iron and steel, communications and transport) have set up a joint ENI-IRI committee to coordinate policies with regard to materials.

One of the first objectives is the setting up of a small strategic reserve of advanced materials, partly as a precaution against the recent cultural embargo imposed by the United States which has slowed the flow of information with regard to high technology. A second objective is that of involving small- and medium-sized companies in the new processes for the design and creation of special materials. According to Franco

Sandrolini (who teaches materials science at the University of Bologna, a course which operates closely with business and industry), the role that smaller companies will play in the field of advanced materials will correspond to their importance in terms of employment in the general economic system (where they employ approximately 80 percent of the total labor force and have a high turnover/staff ratio). This is partly the result of the very high degree of specialization needed for the processes that take place further down the line. The following are the development prospects for the various materials based on a series of reports drawn up by FAST (Federation of Scientific and Technical Associations) on behalf of the CNR (National Research Institute).

Composite Materials

Composites resulting from the mixture of several different substances are the most important form of technology as far as the future development of new materials is concerned. World consumption of advanced composites reached 11,000 tons in 1984, worth $1.3 billion, at a growth rate of 16 percent. The appearance of these materials will chiefly be to the detriment of materials such as plastics and aluminum, widely used as matrixes and binding agents.

The Situation in Italy

The development and application of the few companies operating in the field of advanced composites are clearly not helped by the fact that the largest users in Italy (the companies operating in the fields of defense and aerospace) have had to make exclusive supply contracts with American companies, especially for carbon fiber composites. Montedison is very much involved with the attempt to get composite materials off the ground and has recently taken over from Biinvest five small to medium sized companies operating in the field (including Nolsa of Milan, a market leader in the production of safety helmets), grouping them together under the name of Tecnocompositi.

SAMIM of the ENI Group has also stepped up research into composites with a metal or ceramic matrix and has purchased know-how from abroad.

The Experience of the Companies

One of the leading companies in the use of carbon fiber is Reglass of Minerbio (Bologna) which was founded in 1981,to produce resin glass reinforced plastic fishing rods. At present, the company uses about 10 tons of carbon fiber a year, second only to Aeritalia. The company employs a total of about 20 staff employees and its 1985 turnover was over 2 billion lire, 40 percent of which came from abroad.

The owner of the company, Luca Pirazzini, has persistently developed research into new composite materials, passing to the use of Kevlar and then to carbon fiber, which increases strength by 40-50 percent and is easy to work with even at high temperatures.

Reglass has also extended its range of products (all in carbon fiber,) from fishing rods to ski poles), laminated valves, X-ray tables, and pipes and tubes for high precision instruments and robots. It has also gradually increased its share of the foreign market, supplying customers such as the United States' General Electric company.

Pirazzini's work in the development of new applications for composite materials continues: 10 percent of the turnover is invested in research and the company recently commissioned the Rizzoli Institute of Bologna to test the biocompatibility of carbon fibers with the grafting of fiber plates in living organisms. More important experience has been gained at Gaeta where Italcraft, with 180 employees and a turnover of almost 4 billion lire in 1985, was the first naval dockyard in continental Europe to use Kevlar in the construction of its boats (1975).

As the managing director, Sergio Sonnino Sorisio, explains, Italcraft has a range of motorboats between 8 and 21 meters in length and uses Kevlar for models that need to be extremely lightweight (and therefore fast) and yet strong. Some boats are used for passenger traffic, but the most frequent uses of kevlar are for craft to be used by the navy, customs authorities and the carabinieri. Most of the production is exported since at the moment the Italian market is at a standstill. About 30 percent of Italcraft's human and financial resources are devoted to research, and the results achieved are highly advanced. The recent M 78 (21 meters, 35 tons, 60 knots) is one of the fastest diesal motor yachts in the world and allows a fuel saving of around 40 percent.

However, before a turning point toward mass applications of thermoplastics can be reached, more must be learned about their long-term behavior under conditions of dynamic stress.

Plastics for Electricity

Already widespread, and becoming more and more sophisticated, is the use of additives with plastics to achieve special performance in terms of mechanical strength and flame resistance, or to create additional properties of insulation or electrical conductivity. It is in this latter field that the most important new developments are to be anticipated.

One of the most important objectives of research is to replace the metals normally used for electric cables with conductive plastic so that the cables would be self-insulating and need no outer coating. In the opinion of Giovanni Canalini, managing director of Italplastics in Beverate (Como), the economic savings brought by conductive polymers would justify a reorganization of current energy distribution parameters: by reducing the power difference (to between 10 and 20 volts), the production of heat would be reduced (Joule's law), thus avoiding the risk of the polymers melting and ensuring long life.

Technological Innovation

Industry has made great progress in plastics with regard to the development of innovative processes for exploiting existing products to the full, both through the recycling of waste and by means of new, revolutionary processing methods.

For example, Montepolimeri of the Montedison Group has developed a catalyst able to produce polypropylene polymers of a regular, spherical shape, skipping the phases of separating and purifying the polymer from the catalyst residue and also the final granulation phase.

This system reduces the industrial costs of monomer-polymer transformation from 171 to 59 lire per kilo, that is, about 65 percent Italplastics is also studying a project to eliminate the final polycondensation phase, obtaining finished products in nylon 6 directly from the caprolactal monomer which is poured into the molds in its original form.

In the field of surface treatments, the Istituto Donegani has developed a technology for external coating with polymer film (known as conformal coating): The film is vaporized onto the objects and adheres perfectly to all shapes, making them impermeable to gases and vapors and to biological and chemical agents, thus creating excellent electrical insulation. Proof of the industrial and commercial validity of this technology is the fact that it has recently been purchased by American companies for the protection of integrated circuits, aircraft components, military equipment and biomedical apparatus. Montedison has recently started negotiations to market the technology in Europe.

Future developments of this material will concern the simplification of the processing techniques (elimination of the vacuum chamber) in order to obtain film with slightly lower performance at much less cost (at present conformal coating costs 1 million lire a kilo). Its applications could then spread to the protection of electronic systems for automobiles, washing machines, and various other products.

The Experience of the Companies

Giovanni Canalini, a former university research worker and then coordinator of ANIC's plastics laboratory, in 1977 became managing director of Italplaxtics S.p.A of Beverate (Como), a company operating in the field of granulation and coloring of second grade plastics (with an output of 700 tons a year). He started "compounding" activities within the company, consisting of the modification of polymers supplies by the petrochemical companies in order to achieve special mechanical properties such as flame resistance and conduction of electricity. In 1985, Italplastics, with its 32 employees, produced 7 thousand tons of technopolymers (engineering polymers), with a turnover of approximately 15 billion lire. The turnover will double as soon as a new production plant, with a capacity of 5 thousand tons, starts to operate.

The company exports 36 percent of its production and its most advanced engineering polymers find their chief customers in Germany (Daimler Benz, BMW, AEG and Wuhner). Italplastics is engaged in work to develop applications for automobiles, the mechanical industry (as substitutes for light alloys), electronics (bodies for TV cameras, electronic instrument containers) and for chemical systems (ventilation and solvent pickling plants). For the last of these applications, it uses polymers that are made to conduct electricity by the addition of cabon black and which are well known for their ability to act as shields against electromagnetic fields and radio interference.

Among the projects being studied is one aimed at creating a line of plastics which are not only flame resistant but also smokeless. The development of a process to obtain nylon engineering polymers by pouring the caprolactam monomer directly into the mold (thus eliminating the transformation and modification phases) is also at an advanced stage. By reducing the processing phase it is possible to cut energy consumption by about 20 percent, with a consequent reduction in the cost of the polyamides. One of the possible applications being studied is that of producing a car built entirely of plastic.

Ceramic Materials

Ceramic materials have excellent growth prospects because of their potential application in mass sectors and of the unlimited availability of the necessary raw materials (silica, alumina, rutile, zirconium and boric products).

According to Renato Guerriero, director of the Veneto Research Institute of SAMIM (ENI), widespread use of ceramic materials could have an impact similar to that already obtained by plastics and aluminum, and the business linked to the development of new products will be so vast that the risk margins to be faced by operators entering the field for the first time will be extremely low. The annual growth rate of the world market is likely to be around 10 percent and the turnover should rise from $4 billion in 1980 to $17 billion by 1995.

Developments

According to research carried out by SAMIM (a company in the ENI group), the prospects for advanced ceramic materials are extremely wide. The main ones are examined below:

--Antifriction systems. Their hardness and resistance to high temperatures means that ceramic materials are suitable for the manufacture of components which operate under aggressive conditions (bearings, gaskets, nozzles, extrusion dies, etc.) which at present are normally made of special types of steel. Ceramic ball bearings are at the moment used for military and aerospace applications, since their price (about 10 times greater than metal bearings) prevents them from being more widely used.

--Cutting tools. As with the anti-friction systems mentioned above, the use of ceramic materials for cutting tools will depend on the saving of strategic materials. At present only 5 percent of all cutting tools are made of ceramics (chiefly alumina, and silicon carbide). In the United States this figure is expected to rise to 7-8 percent of the total market by 1990 and 10-12 percent between 1995 and 2000. In Italy, the cutting tools market has a turnover of 6,000 billion lire and consists of about 400 million items (20 million of which are manufactured in Italy), of which only 2 percent is made of ceramic material. Therefore, the market space available is very large indeed.

--Heat engines. The use of ceramics in internal combustion engines and turbines is likely to be one of the most important and useful of future applications. The greater thermal efficiency will allow energy savings of 10-15 percent as compared with the present situation (American government forecasts put this figure as high as 27 percent as far as automobiles are concerned).

Even only partial use of ceramics in the automobile industry (to replace certain components) would lead to a reduction in weight and to greater mechanical efficiency (less friction).

--Heat exchangers. The introduction of ceramics in heat exchange systems will make it possible for higher temperatures to be achieved (over 1000° C) with an energy saving which, for Italy, has been estimated as 1 percent of the country's total energy consumption.

The Italian Situation

The conclusions of the FAST report on ceramic materials makes mention of some valid work that is being carried out in this field (sensors, biomedical ceramics, automobile spark pluts). On the whole, however, the Italian ceramics industry does not possess an adequate capacity to develop special materials. The market is almost totally dependent on imports, while as far as raw materials are concerned it would be possible to depend far less on materials from abroad.

SAMIM has recently become engaged in research work into advanced ceramics (with a budget of 30 billion lire over the next 3 years) and has started a joint project with the German company Karl Hertel for the production of samples for engine components and for the development of processes which guarantee the repeatability of the products.

Together with the American company MER, Montedison has recently formed a company (the Keramont Research Corporation) with headquarters in Tucson, Arizona. Before the end of the year the company will start pilot production of ceramic powders (based on zirconium and alumina) as well as a certain number of product lines. Applications will concern the electronics industry (bases for microcircuits, sensors, windows for lasers, motor and engine parts, cutting tools, and heat shields).

The Experience of the Companies

FER of Seregno, which operates in the field of technical ceramics (insulators and miniaturized parts for electronics and electrotechnics), started production of advanced ceramics in 1983. The line produces sensors in zirconium oxide (doped with yttrium oxide) which are able to measure the quantity of oxide present in furnaces and which, coupled to an electronic converter, permit continuous regulation of combustion, with considerable energy savings.

The same sensors, with some modifications, will be applied to automobile mufflers to act as anti-pollutants. Such products are new not only in Italy but also to other European countries where business agreements with FER have already been reached. Within a few years the current one hundred or so items will become one thousand and the turnover for this product line alone will be 500-600 million lire (FER's overall turnover in 1985 was about 7 billion lire. The company employs around 100 people).

The idea came to managing director Rinaldo Piva at the end of the 1970's after reading specialized American and Japanese magazines. He then purchased in the United States a furnace able to reach the 1,800° C needed to sinter (bake) the zirconium oxide powders (which also were imported from the United States). The cost of the raw material is very low but its value increases tenfold after treatment with yttrium oxide, which modifies its crystalline form.

Metallic Materials

Future Prospects In Different Sectors

Research carried out by Finsider's Experimental Metallurgy Center has identified the future prospects of steel in some sectors. We examine them below:

--The transport industry. Steel, although heavy, has good mechanical properties even at medium temperatures, and must be compared with titanium, which has similar characteristics and is lighter but more expensive, and plastics, which are cheap and lightweight but which do not always possess good mechanical characteristics, especially at high temperatures. The short and medium term prospects (especially as far as automobiles are concerned) are therefore reasonably good for steel, which is now also processed into ultra-thin, highly resistant sheets.

--Food packaging. In this sector, aluminum and, above all, plastics, are gradually replacing steel which, however, can defend itself with less expensive coated products of a completely new design.

--Process industries. In the food and pharmaceutical sectors, where the main requirements are reliability and hygiene, steel will continue to be dominant, whereas in the chemical and petrochemical industry it is very likely that the use of plastics and fiberglass reinforced plastic,

especially for low temperature and low pressure applications, will continue to increase.

--Energy. Steel will continue to dominate.

--Tool-making. With the constant pressure exerted by other materials such as carbides and ceramics, steel will suffer slight setbacks, although it could also improve its position in some sectors due to powder metallurgy technology.

--Electrotechnics. The market for magnetic sheet steel is not at all vulnerable. Some competition could come from new, ironbased materials or from the new technologies (such as powder metallurgy) developed by the iron and steel industry itself.

The Situation In Italy

In steel production, Italy holds sixth place in the world and second place within the EEC.

Until 1980, the industry concerned itself chiefly with mass produced products, but now tends to aim at products with a higher added value and higher technological content: for special steels it has managed to achieve a trade balance. More than 50 percent of the output is produced through continuous casting, a figure exceeded only by Japan.

In the field of innovative materials and technologies, things are only now starting to move. After being at a standstill for 10 years, Finsider's Experimental Metallurgy Center has switched to new materials and processes (including powder metallurgy) and is carrying out research into ways of integrating materials and finished products.

However, the national iron and steel research program approved by CIPI 18 months ago has still to get under way.

The Experience of the Companies

Pierluigi Deserti, the owner of the Fluid Center of Molinella (near Bologna) has a real vocation for research and innovation. In 1977, he started to build machinery 30-50 meters long for the internal grinding of steel pipes (widening of the hole to the nominal diameter and planing of the surface to achieve a roughness of 0.2 microns, that is, thousandths of a millimeter). His is now the only works in Italy to be equipped with an automatic system for the assembly and disassembling of pipes for this type of process.

Two years ago he started production of special steels treated with the induction hardening system. This technique brings the steel to a temperature of 850° and then lowers the temperature suddenly to 400° C. The steel thus acquires a very high degree of surface hardness.

This product, strong on the outside and malleable on the inside, is particularly suitable for the small-scale production of special parts for robots and machine tools.

The Fluid Center produces 8,400 tons of induction-hardened steel a year, half of which is sold abroad. With 20 employees, Pierluigi Deserti's Center achieved a turnover of almost 8 billion lire in 1985 and this figure seems likely to increase by 30-40 percent in 1986. In the next few years, Deserti intends to introduce new techniques and systems, with 8 percent of the turnover being reinvested in research.

Aluminum

Of all nonferrous metals, aluminum is the most important from an economic viewpoint and is used chiefly in the transport and building industries. Over the last few years consumption of aluminum has risen very steeply, reaching saturation points in the more highly industrialized countries.

New Applications

Ettore Russo, director of EFIM's Experimental Institute for light metals, explains that possible new applications of aluminum are to be found in the aircraft, aerospace and defense sectors, for which new alloys with greater mechanical strength, toughness, ductility and resistance to corrosion are at present being studied.

The Situation in Italy

Italy's strategic dependence in the field of nonferrous metals is very high, particularly with regard to copper and lead of which Italy is the world's leading importer in relative terms (ratio between imports and consumption.

The main research ventures are being carried out by SAMIM, which specializes in the procurement of strategic materials. At the present moment SAMIM is setting up a research center in Sardinia, dealing with primary metallurgy, and has also enlarged the CERIVE (the Veneto Research Center).

Led by Prof Renato Guerriero, the CERIVE studies process innovations for the entire cycle of materials and has a research line engaged in the study of refractory, composite and semiconductor materials, which is carried out in collaboration with the Massachusetts Institute of Technology.

Semiconductors

These materials are highly conductive when current passes through them in one direction, while acting as insulators when the current passes in the opposite direction. They are used in microelectronics, in the manufacture of integrated circuits, microprocessors and memories; in telecommunications, to amplify optoelectronic signals, and in infrared sensors, as light detectors.

As far as microelectronics is concerned, SGS of Agrate (the only Italian producer) predicts a world market increase over the next few years of around 17-18 percent, which will involve a parallel increase in the number of the pieces but a smaller increase in the consumption of materials because the processes used will be more efficient.

The Italian Situation

In Italy the start of the national microelectronics program, which will involve 18 different companies (led by SGS) in the construction of a network of integrated circuit laboratories, should spur the sector on and also involve many small- and medium-sized companies.

As far as base materials are concerned, SAMIM has plans to start the production of silicon and galluim arsenide from the aluminum minerals used by the EFIM Group. The gallium arsenide will be used in telecommunications and in the aerospace and energy industries so that a small, but strategic, national stock of the material will be formed.

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WEST EUROPE/ADVANCED MATERIALS

BRIEFS

MAJOR FRENCH MATERIALS INITIATIVE--The French Ministry of Research and Technology is launching a "Materials Development Program" in which the primary objective is to improve links between academics, researchers, manufacturers, and end-users. This project is led by a 14-member council associating representatives of the relevant industrial sectors, scientific experts, and top officials. Priority activities: training, support in shifting from traditional materials, composite material research and applications, fine ceramics, polymers, and new electronic components. With 2 million jobs and a Fr 700-million turnover, the materials sector represents an important economic reality. Furthermore, this sector alone receives almost 10 percent of all research funds. [Text] [Paris SCIENCES & AVENIR in French Apr 86 p 10] 25004

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DORNIER FACES OBSTACLES IN DEVELOPMENT OF COLUMBUS MODULE

Stuttgart FLUG REVUE in German No 3, Mar 86 pp 83-4

[Article by Gotz Wange: "Space Technology: Resource Module For Columbus. Self-sufficiency". First paragraph is FLUG REVUE introduction]

[Text] The slowdown in the American space program is not entirely inconvenient for the Europeans. Constant changes are making definition of ESA [European Space Agency] participation in the U. S. space station more difficult. The German component is especially affected.

Dornier's space managers in Friedrichshafen are finally beginning to see land. After a long and tenacious struggle, they are nearing a technical concept for the so-called resource module, an element in the design of a European space station. Since the beginning of 1985, a definition study (project name Columbus) directed by MBB-ERNO under an ESA contract for approximately DM180 million has been in progress. It is supposed to define the European contribution to the U. S. space station. Under the leadership of the Italian company Aeritalia, the design for a manned laboratory module modeled after Space lab is being developed. In France, Aerospatiale is responsible for a service vehicle; British Aerospace is designing a free-floating platform; and Dornier is working on the resource module with which Columbus could be supported independently of the U. S. station.

Obviously, Dornier managed to catch the most difficult morsel. It is not that the resource module is more demanding technically than the other Columbus components. The problems lie more in the political area. NASA, for example, looks with great suspicion at any design that would make the European part even partially independent of the main station. Despite personal efforts by ESA general director, Reimar Luest, the Europeans were unable to eliminate the American objections on this point. The resource module is a particular problem in this regard because it would enable Columbus to operate in space with a certain degree of autonomy.

Dornier managers learned during their first proposal presentation how difficult a technical design for the resource module is in this atmosphere. They had proposed a module for Columbus in line with the autonomy in space which Europe has aimed at for a long time. The module provided for electrical energy, its own propulsion unit, systems for data management and attitude

correction as well as a manned pressurized cabin. In the final analysis, all of these are services which a docked laboratory module would normally receive from the main U. S. station.

With this approach, the Dornier technicians would not only have exceeded NASA's tolerance threshold, but their European partners also would have been limited because a multipurpose resource module would have reduced the outlay for the other Columbus elements.

As a consequence, Dornier people were held back. While other Columbus component contractors already had entered phase B, ESA prescribed a pre-phase for the Germans in June and July of last year. Also, the requirements of the users have been thoroughly reexamined. "With regard to the question of maximum availability of energy, it must be decided from a standpoint of cost where the financially acceptable design point is. If, for example, a scientist needs 3 kW for a microwave remote reconnaissance experiment and the next requirement is for a maximum of 1 kW, or if the highest data transmission speed requirement for a single experiment is 300 MBPs, but the next requirement is 100 MBPs, then you have to compromise," explained Gerhard Rausch, acting manager for Dornier space sales.

During the definition of the interfaces with other Columbus components, most contacts were with the British since the free-floating platform--whether in a co-orbit with the space station or in polar orbit--needs almost the same support as the other Columbus components on excursions from the U. S. main station. A duplicate version of the resource module--one designed by the British for the platform and the other made in Germany for the remaining part--is not a cost effective solution in Dornier's view.

Since November of last year, intensive coordination discussions have been taking place between Dornier and British Aerospace. The objective is to establish identical technical specifications for identical functions. But a single resource module will not be sufficient for operational reasons. "However, it is conceivable that a common design will be realized for the fuselage or basis of the resource module," says Gerhard Rausch. The energy supply system with its solar paddles, the thermal system with its two thermal radiators, and the attitude control systems lend themselves to common solutions.

However, there will be differences in some details. For instance, in the solar generator which Dornier has subcontracted to AEG, each of the two solar paddles should reach 27 m in length and 8.52 m in width. When extended together they are to be capable of providing 14 kW of output. The polar platform--unlike the co-orbiting platform or the free-floating Columbus laboratory module--requires a rotating solar system because the reconnaissance experiments must always face the earth, while the solar panels always have to face the sun.

Paddles Folded In for Transport on the Shuttle

Also, the propulsion module must be different for the co-orbiting and the polar platform. The Dornier resource module will be equipped with four 400 N

engines for departure from the U. S. space station and with 12 mini-units for altitude control. However, the polar platform requires much higher power. Every 3 years the platform must be brought down from its orbit of 600 to 800 km to an economical orbit for the shuttle (200 to 300 km) for refueling and service by the shuttle. Subsequently, the platform must be returned to its original orbit.

Commonality exists, for example, in the thermal radiators--two extendable hybrid radiators, each 10 m long. The components are being developed in a special technology program by Dornier, British Aerospace, and Fokker.

Fully fueled, the resource module will weigh 10 metric tons. In order to fit into the shuttle cargo bay, the dimensions have been set at 8.88 m length and 4.40 m width with all solar panels and radiators retracted. In orbit, the spiderlike resource module reaches an overall length of 62.15 m with the solar paddles.

Even before the Challenger accident it became evident that design phase B1, originally scheduled to end in April, would extend to the middle of the year. How the temporary halt in the shuttle program will effect the progress of European space station activities is not yet clear.

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WEST EUROPE/AEROSPACE

FRG R&D IN CERAMICS APPLICATIONS IN AIRCRAFT POWER PLANTS

Stuttgart FLUG REVUE in German No 3, Mar 86 pp 66-70

[Article by Helga Hillebrand: "Power Plant Technology: Ceramics Have a Future; Running Hot"]

[Excerpts] It was a bit of a sensation when the Japanese presented a ceramic car engine at the last international automobile show. Low weight, economical operation, fewer components--these were its advertised properties. A new generation seemed to be in the making for the manufacture of engines and power plants.

Whereas Professor Dr Guenter Petzow, director of materials research at the Max Planck Institute in Stuttgart, sees great development potential in ceramics. Jost Schmidt, department manager for development at MTU [Motoren und Turbinen Union] in Munich, and Dr Hubert Grieb, technical director of the department for analytics, express considerable doubt. In their opinion, a completely ceramic aircraft power plant cannot be achieved in the foreseeable future. Dr. Grieb expresses his reservations: "We can assume that the requirements for the hot sections of future power plants will outdistance the development of ceramic materials."

But this does not mean a total rejection of ceramic materials. The most important argument will probably be that industry would like to replace the expensive strategic materials used in power plant construction, high alloys based on cobalt and nickel. In addition, it is hoped that the engines will be more economical to run because of the thermal resistance of ceramics, and that structural simplicity could result from higher resistance to wear.

Sensitive Reaction to Shock

The possible applications can be divided into three sectors: ceramics as a thermal shield in the form of a coating in the hot sector of the turbine, ceramics for static components, and ceramics for rotating components. "Important advantages would result from ceramics only if they were used as components in the rotating, hot sector of the power plant, that is, rotor wheels with suitable working life," declares Jost Schmidt. At present, cooling air must flow through the individual blades to prevent the material from burning away. However, the cooling air in the hot sector is responsible for a power loss of five to six percent.

Unfortunately, the use of ceramics, especially in this field, is not yet conceivable. In fact, ceramic materials have a decisive disadvantage: They are brittle and are very sensitive to thermal or mechanical shock. But, in particular, when the engines are revving up, they would be exposed to heavy thermal shock. Furthermore, there would be the additional stress of centrifugal forces. Today's ceramics are not suited to these demands. In this sector, industry does not see a possibility for ceramic components for the next 15 years.

It is an entirely different story with ceramic coatings. Ceramics are used in normal production as heat shields. The SNECMA CF6-80, RB 211, and M 53 as well as all subsequent engines have ceramic coatings for the combustion chamber in normal production. In addition, the V2500, being developed at present with the participation of MTU, will have these protective coatings in the combustion chamber. Temperatures of up to 2,000°C prevail within the combustion chamber. But only about 900°C should impact the walls. The ceramic coating protects against the directly impacting heated gas and against radiation. The ceramic coating absorbs the heat, withstands it, and transmits only a portion of it to the wall. Consequently, either the wall can be thinner, and cooling air can be saved--or higher temperatures may be generated in the combustion chamber. Initial successes have also been achieved with static components made of ceramics. Ceramic-coated guide vanes for the Tornado engine have also just gone into series production. It is true that these vanes must endure high temperatures--no problem for ceramics--but they are under low mechanical stress. Temperatures, however, can be as high as 1,700 degrees centigrade. The coatings are between 0.1 and 0.5 mm thick and are applied by plasma spraying.

One component could be the rotor ring. Test components have already been manufactured and tested. A first use of production parts could be made in shaft power plant of the 1,000 kW class which is being developed.

Search for Better Materials

In an initial research program financed by the Federal Ministry of Research and Technology [BMFT], Daimler-Benz, Volkswagen, and MTU manufactured and tested a whole series of possible components. MTU even built a ceramic demonstration power plant. The test runs produced good results for the static guide vanes. Several thousand stress cycles were run without the appearance of damage (cracks). However, results were less promising for ceramic rotor blades. The break point was reached at speeds as low as between 40,000 and 60,000 rpm, even without additional thermal stress. Because of these results, MTU has postponed further hot cycle tests for the time being.

MTU, together with the Max Planck Institute in Stuttgart and Daimler-Benz, has now applied for a further research program for ceramic materials. Additional tests will then be run with improved materials.

In the future, manufacturers of aircraft power plants hope that ceramic materials will improve. Also, not all materials known at the present time are suitable for use in the power plant field. Only silicon nitride and

silicon carbide are of interest because of their superior thermoshock resistance. The highest operational temperature is approximately 1,300°C for silicon nitride and from 1,600° to 1,700°C for silicon carbide. Besides these two materials, zirconium oxide must be mentioned. The high heat resistance, that is, the low thermal conductivity of this material is crucial. The Max Planck Institute also uses zirconium oxide as a reinforcing material for zirconium nitride (see "The Tamed Shrew" boxed insert at end).

Ceramics are very prone to failure. Contaminations as small as only 10 to 20 microns reduce stress resistance considerably. In addition, conventional materials test procedures, which must be nondestructive, do not reveal contaminations smaller than 50 microns. Users of ceramics must therefore face the problem of structural integrity. Even during the production process of the material it must be ensured that such particles are not present in the ceramics. Clean room conditions are therefore essential during the manufacturing process.

Originally it was assumed that ceramic components would be inexpensive, since the basic material was considered cheap. Scientists now challenge this notion. An optimized ceramic material has no price advantage since the manufacturing requires too much outlay.

Engineers will have to change methods. Ceramics are fragile when the component has sharp angles. All bevels must be rounded by radii. Thus there will be no notching action during mechanical stresses and the component will not break so quickly. For example, this is the case at the bladeroots 8 kW. For rotating blades, MTU will therefore use one-piece wheels and will not install single blades in the wheel. However, this technology is used only in small gas turbines of up to 1000 kW. This turbine could be used as a power plant for helicopters or small business jets.

This, too, will have to wait for some time. First steps in the utilization of ceramics have been taken but they certainly cannot yet replace conventional metals. But in the area of casing construction and stators, ceramics show good possibilities.

(Box, p 69)

Research: Structural Modifications in Ceramics; The Tamed Shrew

Ceramics are brittle by nature. They break abruptly. But for the maintenance of technical components, slow breaking is necessary. A method developed by the Max Planck Institute in Stuttgart reduces ceramic brittleness.

The objective of material science is therefore to tame brittleness. For years Prof Guenter Petzow, director of the powder metallurgy laboratories at the Institute for Metallurgical Science of the Max Planck Institute in Stuttgart, and his colleagues have been conducting research in this field. And they can show some results. The resistance of these modern high performance ceramics has been increased by a factor of ten compared to classic procelain. Ceramics with stress resistance of 800 to 850 Mega-Pascals at temperatures of 1,000°C can now be manufactured. The goal, which will certainly be reached in the next few years, is bending stress resistance of 1,000 Mega-Pascals at a temperature of 1,500°C.

The scientists in the Max Planck Institute in Stuttgart first considered ductilized ceramics. In this case, metal particles are added to the ceramic mass during manufacturing. The result was a ceramic material with a flatter break curve. However, the ductilized ceramic could not be used technically, because strength had suffered greatly in the process.

But Petzow and his colleagues were successful with so-called transformationally strengthened ceramics. Aluminum oxide is the basic ceramic material here. Into this brittle matrix, particles of zirconium oxide of 0.5 to 1 microns are inserted. These particles change their crystal structure at a temperature of approximately 1000°C and expand at the same time, a process dubbed transformation. The expansion of the zirconium oxide particles creates an inner stress in the ceramic material and these pressure stresses counteract the external forces of traction which could produce cracks. They branch existing cracks and break slowly, hindering abrupt breakage.

But not all particles undergo the transformation uniformly during manufacturing. Smaller particles remain in an unstable state. However, if a crack occurs, the transformation is also induced in these particles. They expand--and close the crack. Thus, in transformationally strengthened ceramics, two mechanisms are active against the proliferation of cracks and against the sudden, uncontrolled break. The taming of brittleness has started.

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WEST EUROPE/CIVIL AVIATION

AIRBUS INDUSTRIE BEGINS DEVELOPMENT OF TWO NEW AIRCRAFT

Stuttgart FLUG REVUE in German No 3, Mar 86 p 44

[Unattributed article: "Air Traffic: Two New Types of Airbus. A Complete Family"; first paragraph is FLUG REVUE introduction]

[Text] With two new airplane models, the A330 and the A340, the European firm Airbus Industrie finally intends to challenge the American competition. The basic A300 and A310 models are getting an addition to the family. A complete airplane family is emerging.

It is true that the British are signaling problems and are asking London for complete financing. But since the partners seem prepared to take over the part of construction assigned to British Aerospace, no real problems should be expected for the new program. With the two new types A330 (previously designated TA-9) and A340 (previously TA-11), the European Airbus Industrie is pushing into market sectors previously reserved for the American competitors, Boeing and McDonnell Douglas.

The board of directors has given its "go ahead" for the definition phase and opened the way to define the final design of the two planes jointly with possible launching customers. Before the end of the year, the green light will be given for actual development, as soon as financing has been cleared by the four governments. Both aircraft could be on the market by the beginning of the 1990's.

The development cost, estimated at $2.5 billion, includes an improved wing for medium and long distances to be used on both types. The fuselage and systems will also be largely identical for both types. The crucial difference is in the number and thrust of the engines: Whereas the A340 long range aircraft, designed to 260 passengers, will be equipped with four engines with 30,000 lbs thrust each, possibly the CFM-56-5 or the V2500--Lufthansa has been pushing for the construction of this prototype for a long time and has explicitly welcomed the start of the new phase--the A330 medium range aircraft, capable of carrying 400 passengers, the largest Airbus model yet, will be powered by two engines with 60,000 lbs thrust each.

During the current definition phase, self-financed by the four partners: Aerospatiale, British Aerospace, MBB and Casa, not only must the technical

design be developed but also contractual conditions for future customers and division of work among the partners. As in previous programs, interested customers like Lufthansa will contribute their engineering knowledge in this early design stage.

Work on the two models will also give new people in the management of Airbus Industrie a chance to earn their spurs: Henry Martre has been elected vice chairman of the board of directors, replacing Bernard Lathiere, former president of Airbus Industrie. Britain's Stuart Iddles is replacing Pierre Pailleret, who was responsible for sales, on the board.

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WEST EUROPE/TECHNOLOGY TRANSFER

NETHERLANDS RECONSIDERING COCOM SOFTWARE RESTRICTIONS

Amsterdam COMPUTERWORLD in Dutch 11 Feb 86 p 1

[Article: "COSSO and VIFKA Will Possibly Take Part in the COCOM Discussion"]

[Text] Amsterdam--The Ministry of Economic Affairs has told the Association of Computer Service and Software Organizations (COSSO) and the Association of Importers and Manufacturers of Office Machines (VIFKA) that it is prepared to consult closely to see to it that as few restrictions as possible are imposed on software product exports.

Both COSSO and VIFKA will participate in an upcoming discussion to determine the position of the Netherlands within the international COCOM discussions, which determines restrictions on exports to East Bloc countries. The Netherlands' position must be determined by 6 June at the latest.

The next COCOM deliberation, in which the export of software products will come up for discussion, is expected to take place late this year or in the spring of 1987. It is possible that both industry organizations will be able to join in these talks directly too.

General Licenses

Regarding the export licensing system for strategic goods, exporters from the Netherlands will receive the same treatment as their British competitors. Therefore, companies which apply will receive a general export license for software. This license is not valid for products mentioned in the appendix of the strategic goods implementation decree. As mentioned in the 21 January 1986 issue of COMPUTERWORLD, this list was revised on 1 February 1986.

This list includes military goods, software for computers designed in the East Bloc, and software designed or adapted for security or cryptologic/cryptanalytic applications. Furthermore, it concerns software designed or adapted for computer-aided design of semiconductors and/or microcircuits and programs for designing, developing or manufacturing the excluded software.

Unless withdrawn, the proposed general licenses will be valid until the end of the year. Even if they are not--yet--considering software exports, COSSO nevertheless advises its members to apply for this general license.

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EAST EUROPE/COMPUTERS

JOINT OPERATION OF ESR SVM, SVS OPERATING SYSTEMS

Budapest INFORMACIO ELEKTRONIKA in Hungarian No 1, 1985 pp 33-38

[Article by Sandor Csizmazia, Anna Recski and Ference Roman: "Experiences With Joint Operation of ESR SVM and SVS Operating Systems"]

[Text] Theme codes: 32 (operating system) and 72 (comparative analysis).

A new ESR operating system, the SVM (System Virtueller Maschinen), arrived in Hungary in the fall of 1983. The article describes practical experiences with operation of SVM and making systems more efficient.

Arrived: 16 October 1984.

Antecedents

In the last quarter of 1983 a client of SZAMALK [Computer Technology Applications Enterprise] purchased an ES 1055 computer manufactured in the GDR, with 4 M bytes central memory and a rather large background memory. The machine supports virtual memory management.

Description of Operating Systems

The German side was able to deliver or sell three types of software for the machine:

--a machine oriented system (OS 6.1 M8 distributive system and its subsystems), see figure 1,

--an SVM system, see figure 2, and

--problem oriented systems (for example, a data base management system and a mathematics program package), we will not deal with this last item.

The OS System

The following belong to the machine oriented system:

--basic operating systems: MFT, MVT, SVS. Only the MFT and MVT can be used on the series I ESR machines, the SVS system can operate only on series II ESR machines making virtual memory management possible.

--basic compilers: PL/I, COBOL, FORTRAN, RPG, ALGOL and SORT/MERGE. These batch compilers can be used in all three basic operating systems.

--developed compilers: Assembler II, further developed COBOL, COBOL prompter, conversational COBOL, PL/I optimizer, PL/I checkout, FORTRAN G1, FORTRAN CODE and GO and SORT/MERGE II. All the possibilities of the COBOL prompter, conversational COBOL and PL/I checkout can be exploited only in the conversational mode.

--conversational systems: CRJE, TSO. In its present version TSO still works only in the MVT system. CRJE can be used in all three basic operating systems, but since it is rather obsolete it provides only very few services to the user.

--spooling system: SPAM. This spooling system, which can be compared to JES operating in OS/VS1 to a certain extent, can be used only in the SVS operating system. SPAM is optional, we have to decide at the time of system generation whether we want to use it. It is a substantive restriction that SPAM and CRJE cannot be used jointly but only separately.

The SVM System

The SVM system belongs to the second group. The SVM system is comparable to the IBM VM/370 system, and the essential thing is that under it one can run several operating systems on the same computer at the same time. For example, if an OS system and a DOS system are being used off and on in a computer center then one can imagine a solution where the OS and DOS would run at once under SVM.

The SVM system developed from the meeting of two software development trends. The first represents the principle of multiprogramming, the purpose of which is better exploitation of resources. To do this the (only) central unit is not put in the service of one process exclusively but rather a number of processes will use it overlappingly. (This possibility existed on every machine which worked with an interrupt system.) The other trend, introduction of the principle of virtuality, appeared later in time and meant that in the interest of better exploitation of one physical unit a number of virtual copies of the unit are made or simulated in memory or in a disk area and these, also overlapping, supply the real physical unit with work. The first step in this process was simulation of the memory in some disk area, later in VM/370 and then in SVM they simulated I/O units and, indeed, entire computers. So the goal was to execute the activities overlappingly and to use, by simulation, the tools necessary for the activities. The SVM system satisfies these requirements.

The SVM operating system can simulate in one given computer a corresponding number of virtual machines. These virtual machines can be initiated from console or terminal. The operator at the terminal can operate the system as the operator of the given operating system and, on the other hand, as a user of the system. The functions of the physical devices which can be found on the operator's console of a real machine can be used by the operator of the virtual machine with the aid of commands.

In addition to coordinating the work of the virtual machines the SVM system supports efficient conversational program development, use of remote terminals and evaluation of system errors with special procedures. Accordingly SVM has four main parts:

--the control program (CP),
--the conversational program development system (PTS),
--the system handling remote terminals (RFTS), and
--the error analyzing system (PDAS).

The latter--the PTS, RFTS and PDAS--are individual operating systems each operating in a virtual machine.

Detailed description of the components:

1. Functions of the control program:

--distributing the resources of the real machine,
--scheduling the I/O operations,
--handling various interrupts,
--handling the multilevel virtual memory, and
--distributing use of the central unit.

2. Possibilities of the conversational program development system:

--creating files,
--editing files,
--translating, running and testing programs, and
--efficient data movement among the virtual tape units, readers, printers, punches and disk units.

3. Task of the system handling remote terminals:

--providing a link between a remote terminal and a virtual machine, data movement.

4. Task of the error analyzing system:

--discovery, correction and collection of system errors with conversational tools.

Connection of VM With the Virtual Machine Running Under It

There are a few operating systems using virtual memory which were prepared for possible operation under VM. When running under VM such an operating system takes cognizance of this fact (that it is under VM) and prepares for cooperation. For example, in the event of initiation under VM, after IPL and during NIP, it issues to VM the command CP SET PAGEX ON, as a result of which, if there is a task in the system awaiting page-in then only this task waits. (If this command is not given then, in the event of a page error, the entire virtual machine goes into a waiting state.) With the aid of handshaking (creating a mutual link) it is also possible to avoid having both VM and the operating system in the virtual machine issue certain privileged instructions.

If handshaking is established there is yet another possibility which greatly increases efficiency--nonpaging mode operation. It is an important precondition for this that the virtual memory provided the virtual machine by VM coincide with the virtual memory of the operating system running in the virtual machine (or, looking from above the virtual machine, that the size of the real memory and the virtual memory be the same). In the nonpaging mode the "real memory" coincides with the virtual memory, thus the operating system running in the virtual machine does not have to page, because this is not needed. Thus only VM pages and so double paging can be avoided.

Of the operating systems used in our country the IBM DOS/VS and OS/VS1 and the ESR SVS system were made for handshaking. An operating system not made for this (for example, IBM SVS) would be so slow under VM that it practically could not be used regularly or systematically.

There is a possibility in ESR SVS which makes it very convenient to send work from a conversational PTS machine to an SVS machine and to get output back from it into the PTS machine. This is a new parameter introduced in the job control language of OS, the VMID parameter, which can be given in JOB and DD instructions and serves the purpose of sending to the card reader of a virtual machine identified by the user in this parameter the lists generated in the course of running the job.

Selecting the Operating System

When selecting the operating system we first took into consideration that because of the guarantee conditions only software of ESR origin could run in the machine. An efficient conversational program development system was absolutely needed for swift conversion from the computer which had been used up to then. The possibilities of the ESR software had to be compared with the requirements being made of the machine. A basic requirement--since it was a series 2 machine--was exploitation of the possibility providing virtual memory management, for this offers a way to handle storage efficiently. On a machine of this size with such a large background memory possibility it was just to require, in addition to batched processing, a conversational program development possibility and, naturally, an efficient spooling system as well.

Of the ESR operating systems only SVS could be considered, since only this system could exploit the possibilities of the machine. The SPAM spooling

system could be operated in SVS but unfortunately, of the conversational systems, TSO does not work in SVS and CRJE cannot work with SPAM. Since CRJE also does not make possible conversational program development, attention turned to SVM, in which there is a system supporting efficient conversational program development (PTS) and in addition it could take over the tasks connected with spooling from the systems runing under it.

Taking all this into considertion it was decided to run SVM on the ES 1055 with an SVS operating system under it--together with PTS machines (figure 3). A serious role in this decision was played by the fact that according to the German experts SVS could attain about 80 percent efficiency under SVM, compared to operation without SVM (we called the latter the native mode or the independent operating mode). Thus the SVM + SVS mode simultaneously satisfies the requirement that there be batched runs, conversational program development and a spooling system in the system.

The systems were created according to plan, and although we received with doubt the promises connected with 80 percent efficiency it caused great surprise that SVS fell quite below the expected efficiency. In regard to running time the ES 1055 machine behaved as if it were an ES 1020. Naturally this was not suitable, so the efficiency of the systems had to be increased, trying out the possibilities for increasing efficiency, separately in the SVM and SVS systems and in the cooperation of the two systems. We report on this below.

Possibilities for Increasing Efficiency

The V=R Area of the SVS Machine

Translating the channel programs requires significant time in virtual operating systems. The large central memory--4 M bytes, large compared to domestic conditions--made possible a significant augmentation of the V=R line in the SVS system, and thus made it possible to run user jobs in the V=R area. In this way the translation of the channel programs in SVS could be avoided and thus the programs for access methods accelerated. By introducing running in the V=R area the efficiency about doubled.

The V=R Area of the SVM Machine

Running is also possible in the V=R area in the SVM system, but there are preconditions for this. The most important of these is that the size of the V=R area must be given when generating the SVM system, and this cannot be changed later. In general the V=R area is created so that the operating system for batched processing under SVM can run in it. A virtual machine is authorized to use the V=R area only if the VIRT=REAL option figures in the directory pertaining to the machine, where we describe the hardware environment. This option can figure in the directory input for a number of machines, but only one machine can use the V=R area at a time--always the one which registers first. So, for example, if we want to operate SVS here we can do so in two ways. Either we get the SVS machine to register first automatically, thus taking the V=R area for itself, or, which is much simpler, the VIRT=REAL option figures in the directory exclusively in the description

of the SVS machine. Running a virtual machine in the V=R area means that the virtual machine uses the lower part of real memory, that is that SVM will not page and it need not compete for memory with the other virtual machines.

This is advantageous in itself, but the real increase in efficiency lies in additional possibilities of operation in the V=R area. The SVM system uses so-called shadow tables to access the virtual memory in the virtual machine running under it; these tables perform mapping between the real memory of the real machine and the virtual memory of the virtual machine. In SVM there is a CP option which can be reached only by the machine running in the V=R area, using a virtual operating system, and it is an option which makes shadow tables superfluous. This means that if we give the CP SET STB VR command from the machine in the V=R area which is operating the SVS operating system, then only SVS translates the addresses, SVM regards every address reference as a real address, and it turns neither to the shadow tables nor to another table connected with paging. This significantly increases the efficiency of the machine operating the virtual operating system running in the V=R area.

(We should note that this pertains only to a virtual system; on the one hand because only in this case do shadow tables have a role, thus only have any sense then, and on the other hand because the first page of real memory, the first 4 K, belongs to SVM, and the machine running in the V=R area gets a page elsewhere in its place. In order to access this area which is elsewhere and not at a real address the virtual machine must modify the real address of the page in its own page table, so it is necessary for the system running in the V=R area to use address translation. Thus, for example, issuing the above option in an MFT system would cause faulty operation.)

There is still another possibility to increase the efficiency of the virtual machine in the V=R area, and this is connected with translation of the channel programs--similar to what was described for the SVS machine. Every channel program in the virtual machine running the virtual system and operating under SVM will be translated twice; on the one hand SVM and on the other hand the virtual system operating under it will perform channel program translation.

There is a CP option in SVM with which we can forbid translation of the channel programs, but we can do this only if our virtual machine is using channel programs to refer only to addresses for which the real and virtual address coincide. It follows that we can use this option only if the virtual machine is working in the V=R area and, in addition, if there is no reference in the channel program to the first 4 K, which belong to SVM and not to the virtual machine.

In order for the machine in the V=R area containing the SVS operating system to be able to issue the CP SET NOTRANS ON command, which forbids channel program translation by SVM, it must be ensured that no channel program can refer to the first 4 K of SVS memory either. In order to do this we must change the SVS nucleus so that the UCB's start above 4 K. This was necessary because in the event of unit errors the SENSE I/O instructions will write the state bytes into the UCB's. And if the UCB's were in the first 4 K then when a

unit error occured--after disconnecting channel program translation--the SENSE I/O would overwrite the SVM nucleus, since actually it is in the first 4 K of real memory.

We should also know that the IPL command issued by the virtual machine will write on page 0 in any case, so we can request disconnection of channel program translation only after execution of IPL. Thus, first we must modify the nucleus when generating the SVS system, then after the IPL given to the SVS system operating in the V=R area we can issue the CP SET NOTRANS ON command. (In addition, leaving out the translation of channel programs accelerates the work, especially when handling index sequential data files.)

(A new modification of SVS has reached the country since then in which the UCB's are placed above 4 K in advance; so in this version it is not necessary to carry out the modification described above.)

Significant increased speed was attained with the above two options (SET STB VR and SET NOTRANS ON).

Recording Certain Parts of SVM in Memory

With the aid of the LOCK command we can record certain pages in memory, thus we can take them out of the sphere of the SVM paging algorithm. Since the unpagable part of the nucleus is automatically recorded it is useful to record the routines of the interrupt handling system and the paging algorithm on the other part of the nucleus. In the system prepared we recorded nine pages. This accelerated operation of SVM.

Using the Resident Lists in SVS

We also tried to make the frequently used modules resident in SVS, but we were able to achieve only an improvement less than expected with this. The most important reason for this is that due to the large storage the frequently used modules are virtually never paged out. Another, also essential, reason is that the German experts provided the distributive system with better resident lists, more suitable for ESR machines, than we were used to in IBM systems.

Disks and Placement of Files

In the case of our client the magnetic disk units operate on two channels so it was possible for us to decide, with careful planning, how to distribute the disks between the channels. In this way also it is possible to attain a substantial increase in efficiency.

The importance of the placement of data files among disks and within a disk is well known and is a factor used in various OS systems everywhere to increase efficiency. For this reason we will deal now only with the disk distribution of SVM.

The goal in SVM also is for the system to tap the several disks as evenly as possible and for the densely used disk areas within a disk to fall at the center of effort of head movement. It is useful to put the address list at the

very beginning of the disk, following which we can make room for the CP nucleus. Then it is useful to leave space for temporary disk areas, thus if there should be a nucleus expansion later it will not be necessary to change the structure of the entire disk. Then should follow the system disk of PTS; this is used densely by conversational machines. If we then designate the most frequently used SYSERR, SYSWARM, SYSCKP areas (containing system error files, the saves needed for a warm start and the saves needed to restart from a checkpoint) they will fall about in the center of effort for head movement. It is also useful to set up a secondary system disk, and the spool/page areas can be placed mixed on both disks. It is useful to put user disk areas and large temporary disk areas on the secondary disk too.

Giving the Advantage to a Virtual Machine in SVM

With the following methods one can arrange it so that SVM will put one virtual machine in a more advantageous position to the detriment of the other virtual machines:

--With the SET RESERVE command we assign a certain number of page frames to a virtual machine, but these remain in the sphere of the paging algorithm. That is, these pages could be paged out, but their place can be taken only by pages of their own virtual machine awaiting page in.

This command can be issued only in one virtual machine, and if the other virtual machines should not have room for new pages then the system automatically erases the occupied area. Issuing the SET RESERVE command is especially useful for a virtual operating system operating in the non-paging mode as mentioned for handshaking, when it is also useful to assign a certain number of page frames to the virtual machine directly.

--When determining the hardware environment of the virtual machine among the directory entries it is possible to give priority for the virtual machine in regard to the scheduling algorithm in the USER instruction. The priority given in this way influences the sequence of the machines awaiting execution in the two lines (WAITQ1 and WAITQ2) in which the conversational or batched processing machines are waiting. This scheduling priority, to which the execution priority is added, gives the sequence in the list (the routine list) whereby the virtual machine at the head of the list always gets control. The value of the priority can be between 1 and 99, the highest priority is 1.

--With the SET FAVOR command we can modify the operation of the execution algorithm so that we can always keep a virtual machine on the previously mentioned run list (with the exception of certain wait states).

Conclusions

A substantial increase in efficiency was obtained with the combined aid of the tools described in the preceding chapter. Both our client and SZAMALK considered the tuning successful, taking into consideration the given conditions and the ESR software environment.

Many problems came to light in the course of increasing efficiency, for example that the analytical methods delivered with the software were not satisfactory. Because of this SZAMALK is now preparing a broad, developed testing and analysis system.

We should mention here that when studying the efficiency of a software system it is worth while to measure the module traffic of the operating system only with multiprogramming on an appropriate scale. We must also see clearly that with the appearance of conversational systems the use characteristics of the machine deviate to a significant degree in day, night and weekend shifts. The need arises to use different resident lists or even a different nucleus in different time periods--in accordance with the peculiarities of the several shifts.

Despite the increase in efficiency the services, efficiency and reliability of the operating systems used did not become satisfactory (for example, using the conversational COBOL error filter did not succeed). For this reason our client decided that in the future there would be a need for more reliable, more efficient software offering a good many more services. The choice fell on the IBM OS/VS1 basic operating system and the GUTS conversational program development system. VS1 has a remote batched processing subsystem (RES) in addition to a spooling system (JES) which fits into the system well (figure 4).

The first tests indicate that the IBM OS/VS1 operating system is at least 20 percent more efficient than the ESR SVS system. Use of the OS/VS1 system on the ES 1055 machine caused no problems; indeed, after minor modifications it is also capable of handshaking and nonpaging mode operation under ESR SVM.

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FIGURE CAPTIONS

1. p 33. Summary table of the machine oriented system provided by the German side. (On the left: "For Series I Machines." On the right: "For Series II Machines.")

2. p 33. The SVM system and summary of the operating systems which can run under it. (On the left: "With Handshaking Possibility." On the right: "Without Handshaking.")

3. p 35. Connection of the SVM system with the SVS and PTS systems running under it.

4. p 37. Connection of the SVM system with the OS/VS1 and PTS systems running under it.

8984
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EAST EUROPE/COMPUTERS

TWO NEW ESR COMPUTERS: ES 1833, ES 1046

Budapest SZAMITASTECHNIKA in Hungarian No 11, Nov 85 p 5

[Article by Zoltan Szabo: "Two New ESR Computers"]

[Text] Two categories have expanded recently in world computer development, the super large computers and the personal computers (increasingly professional and increasingly "easier to understand").

In the first half of the year ESR users became richer by one model in each of these two categories.

The ES 1833

The Computer Technology Coordination Institute developed, with code number ES 1833, the Proper-16/W member of the Proper family already widespread and popular among users. This personal computer controlled by a 16 bit microprocessor is outstanding among the rest of the 16 bit personal computers primarily for its large background capacity, network applications and rich store of applications programs. Its operating memory has 1 M bytes of addressable memory.

A 10 or 27 M byte hard disk (Winchester) store ensures storage and fast processing of large volumes of data. The floppy disk units with a capacity of 360 or 720 K bytes each provide portability of data between machines, archiving and copies for data security purposes.

In a way characteristic of personal computers the machine does not need air conditioning and operation of it is simple and easily mastered. More than 60 ready applications program packages are available to users in the areas of business, accounting, finance, labor affairs, inventory management, engineer design, office applications and text processing. The computer can be programmed well in BASIC, FORTRAN, Pascal, mini-PROLOG and the PL/1 and COBOL languages being prepared. The ES 1833 operates under control of the PROPOS-16 3.0 operating system compatible with the MS/DOS 2.0 operating system.

The Proper-16/W can be connected through a V.24 interface to larger ESR or IBM models and to MSR and Siemens computers as a batched mode terminal (IBM 3780

emulation). A local network, which is supported by the operating system, can be developed from the personal computers.

Nearly 300 of the Proper-16/W personal computers are now in operation among domestic users.

The ES 1046

The other computer we mentioned in the introduction, the ES 1046, is a further developed version of the ES 1045 computer which was developed in the second ES series. Taking the same configurations as a base the performance/price coefficient of the ES 1046 is 1.5 times that of the ES 1045. Going beyond the basic technical parameters, the ES 1046 also differs from the ES 1045 with a broad circle of peripherals which can be connected to the standard interface of the I/O channel.

The ES 1046 computer is made in 11 configurations.

The standard devices figuring in every configuration of the ES 1046 are: the processor; devices for processing in the BASE control and EXPANDED control modes; the entire instruction set for ESR Series I and the majority of the new instructions for series II and III; virtual memory; tools for instruction repetition; an operational memory with 4 M byte capacity (a semiconductor memory made up of 16 bit/capsule capacity microcircuits, ES 3269); a monitor; recording of program events; fast buffer store, 16 K bytes; 6 multiplex channels; and tools for direct control.

The most important supplementary devices (delivered on special request of customer) are: an ES 2345 matrix processor; tools needed to organize a dual processor system; operational memory expansion to 8 M bytes; and 3 channel-channel adapters.

An optional configuration ES 1046 central unit fits into two standard ESR cabinets.

An ML-45 cassette magnetic tape store serves to load microprograms.

Fast operating blocks--logical instruction accelerators--built into the processor serve fast execution of certain automatic and logic operations.

Data traffic takes place via byte and block multiplex channels. Of the four block multiplex channels the throughput capacity of two is 3 M bytes/s, while it is 1.5 M bytes/s for the other two. The two byte multiplex channels operate in the multiplex and monopole modes. The maximum number of subchannels is 256.

Data transmission speed is 160 K bytes/s in the monopole mode and 50 K bytes/s in the multiplex mode.

A maximum of 10 peripheral controls can be connected to each channel. One finds in the ES 1046 a service processor with alphanumeric display instead of the "traditional" control console. Every console operation can be carried out with the aid of 34 display images, in addition to a number of new functions

which could not be executed on a traditional control console. Each of the 34 images--control and indicator--which can be called to the screen can be printed out. The service processor can locate failures with a precision of 1-2 cards with the aid of its microdiagnostic tools, under secondary power and fans.

The majority (95 percent) of the computer's equipment is provided with continual self-check devices; this, together with the software diagnostic tools, makes it possible to identify more than 99 percent of the failures.

The machine automatically corrects and logs a one-time erroneous operation. The chief technical parameters of the ES 1046 computer are: performance (processor) for scientific-technical tasks, 1,300,000 operations/s; for economic tasks, 650,000 operations/s; maximum performance, 3 million operations/s; operational memory capacity, 4-8 M bytes; cycle time, 100 ns; element base, the 500 series Soviet IC's, LSI 565 RU3; operating systems, ESR OS 6.1, OS 7, SVM; multiprogram operation, in MFT and MVT mode and in SVS mode; a maximum of 15 user programs at one time, without restriction; compatibility, with computers of the ESR series I-III and with all ESR equipment (software and hardware); operation, continual, with one or two shift disconnection.

System Possibilities

Dual processor system: common memory field to a maximum of 16 M bytes and inter-processor program linkage with aid of processor signal instruction.

Multicomputer system: direct control devices, channel-channel adapter, with aid of common external storage field. Connection of matrix processor: ES 2345, ES 2700.

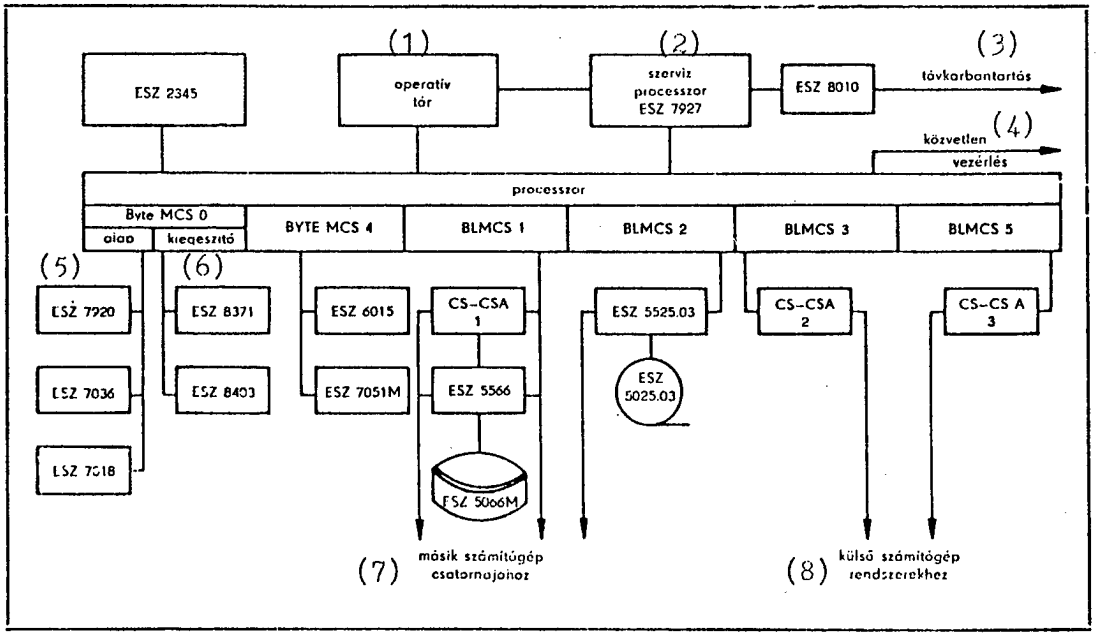
The program tools of the ES 1046 are made up of system and test programs. The system program tools include the OS7 operating system and programming systems for the PL/1, COBOL, FORTRAN, Pascal and Assembler languages.

The virtual machine system makes possible efficient use of all modes and subsystems of ESR/OS7.

The system of test programs, which ensures the operability, repair and checking of the computer, consists of the following parts: a complex program package for technical servicing (an operational testing system and a complex automatic testing system); a system to predict failures; microdiagnostic tests; a concrete version of the ESR operating system; an automatic system to collect and process failure and erroneous operation data; and a local service system.

In addition to what has been listed the software system of the ES 1046 computer includes a number of applications program packages--serving to solve tasks of various types or expanding the functional possibilities of the operating system.

An ES 1046 computer with a medium configuration requires approximately 100 square meters of space in an air-conditioned machine room.



General Configuration of the ES 1046 Computer.

Key:
1. Operational memory
2. Service processor, ES 7927
3. Remote maintenance
4. Direct control
5. Base
6. Supplementary
7. To channel of another computer
8. To external computer systems

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EAST EUROPE/COMPUTERS

THE AULA-3 DESIGNING SYSTEM

Budapest SZAMITASTECHNIKA in Hungarian No 11, Nov 85 p 5

[Article by Laszlo Mohr: "The AULA-3 Designing System"]

[Text] The appearance of prefabricated circuits fundamentally changed the link between users and IC manufacturers. The users, who earlier figured rather as customers, could themselves get into IC design.

In the final analysis this can be attributed to two causes. On the one hand, because of the nature of prefabricated integrated circuits, it is usually sufficient to design the layout of a single so-called metallizing mask in order to realize one circuit function. On the other hand, integrated computerized designing systems were developed to support the several phases of layout design and thanks to these systems even engineers little versed in microelectronics can create their own integrated circuits. Taken together these two factors make possible reliable designing with short throughput times.

It is well known that the ULA (uncommitted logic array) or gate matrix (gate array) circuits play an outstanding role in the family of domestic prefabricated circuits.

The AULA-3 program system developed at the KFKI [Central Physics Research Institute] serves to design these layouts.

The AULA-3 is suitable for designing ULA or gate matrix circuits with optional NMOS, CMOS, etc. technologies.

The essential part of the system is the cell library in which one can find the most commonly occurring logical base gates and stores. At the same time the user can support himself on the experience accumulated in the course of designing practice, because more complex subunits designed earlier also figure in the library. If the assortment is small for the task of the user then he can expand the cell library at his discretion.

It is an especially interesting feature of the AULA-3 that in the absence of a graphic display device the layout can also be displayed through an alphanumeric terminal. This latter device can be found on every computer. With

the aid of the automatic wiring program the layout design for a circuit can be prepared virtually in hours. In such a case the designer need only give the interconnections of the circuit, or locate the cells carrying out the several logical functions on the basic circuit.

Separate programs serve to check the completed design. With the aid of the checking programs one can discover crude mistakes which may occur in the layout (for example, short circuits, outputs bound together) and more complex functional deviations.

In any phase of the designing one can ask for a drawing to check the layout or for documentation purposes.

The mask preparation tool, the tape controlling the figure generator, can be produced on the basis of an error free design.

The AULA-3 can be run on any computer compatible with the PDP 11, working with the RSX operating system and having a minimum memory of 256 K bytes. The programs were prepared in the FORTRAN language, ensuring the portability of the system.

By virtue of the universal graphic interface virtually any graphic terminal (from storage tube type to color raster display) can be fit into the system.

Almost 1,000 pages of user documentation in about 30 volumes aid use of the AULA-3. General descriptions such as "The AULA Purchasing Guide," the "Functional Specifications" or the "Software Interfacing Specifications" facilitate first acquaintance with the system.

The services offered by those who prepared the program system include participation in installation of the AULA-3 and training users to handle the system.

Circuits designed for the leading domestic electronics firms prove the utility of the AULA-3. Some of these are already being manufactured and built into suitable equipment.

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EAST EUROPE/COMPUTERS

PROPER-16 IN HOSPITAL

Budapest SZAMITASTECHNIKA in Hungarian No 11, Nov 85 p 9

[Article by Sandor Raffai and colleagues: "Health Affairs Application of the Proper-16"]

[Text] In the interest of expanding the use of computer technology, and after going through the difficulties and failures of leased processing, the Hospital Clinic of the Gyor-Sopron County Council came to the conclusion that it wanted to raise to a qualitatively higher level the treatment, prevention and closely related economic work belonging in its sphere of tasks by acquiring personal computers at an acceptable price, but at the same time with greater performance.

On the basis of our market research done in 1983 we decided on the Proper-16 personal computer developed and sold by the SZKI [Computer Technology Coordination Institute]. Our choice was also supported by the fact that the SZKI also provided use of the machines within a leasing framework and efficient professional aid from the initial stage, and continuing thereafter.

In the first quarter of 1984, on the basis of a leasing contract, our institution received one Proper-16/A personal computer with a 256 K RAM, two MF 1800 floppy disk stores and a TMT 120 configuration. The software was the Propos-16 (1.0) operating system, a BASIC interpreter, Pascal and SORVAL.

Following arrival of the machine we solved first computerized record keeping and tracking of the cancer screening serving to prevent cervical cancer, which is in gynecology one of the nationally stressed professional target programs.

On the basis of favorable experience and expanding professional information our institute decided for use of the Proper-16/W machines, which have increased background capacity.

The configuration chosen is, per machine:

--one 10 M byte hard disk store, which one has to obtain oneself;
--256 K RAM;
--one black and white display;
--two BASF 6128 floppy disk stores;

--two MF 6400 floppy disk stores;
--one TMT 120 printer; and
--the operating system: Propos-16/W (3.0).

The Systems Implemented

The chief goals of our institution in the area of computer technology applications are, in addition to high level mechanization of the medical administration of treatment activity, providing a computer background for therapy and prevention research and incorporating the technical-economic tasks of our hospital, with about 2,500 beds, into a computerized system insofar as possible. We have designated our chief systems on the basis of these goals.

The Cervical Cancer Screening and Record Keeping Program System

The computer program for prevention and early recognition of cervical cancer with cytological smear tests is one which, in addition to storing and handling data, ensures responsible execution of perfect patient tracking.

In addition to personal data on a patient who goes through the screening test the program makes possible storage and handling of all medical data which could be significant in a positive case and which is suitable for scientific analysis according to many factors (number of births, contraception used, previous cytological results, etc.). Cases needing repeats, treatment or checks can be displayed and the administrative tasks are simplified and made precise with preparation of form letters. This program package can be marketed; by modifying the professional data it could be used in any area.

Record Keeping on Positive Cases of Cervical Cancer

Connected to the computerized system for screening activity, this stores data on the medical treatment of positive cases and aids the precise handling of this patient group in the conversational mode. Using material from 1984 it displays the distribution of cases in absolute numbers and in percentages, reflecting the histological diagnosis, and the table is updated daily.

Maternity Tracking and Record Keeping System

In addition to recording administrative data on pregnant women coming to the maternity department this is suitable for processing 15 pregnant women simultaneously, processing all medical information pertaining to pathological history, admission diagnoses and the course of the birth. The conversational mode ensures retrieval of all information or different types of information, for example relating to diagnosis, at any time in addition to being able to record and query information pertaining to treatment and the results of laboratory tests.

Any change in the dilation of the orifice of the uterus reflecting the course of the birth is portrayed in a diagram. This diagram provides a basis for the possible necessity of intervention in the event of a normal or abnormal birth. After the birth and a period of observation it prepares an archives

copy of the data on the woman giving birth and issues a department placement certificate.

It makes out all the documents that the pediatrician needs in connection with caring for the infant. All this makes possible the precise preparation of the most extensive obstetric data and statistics.

Laboratory Program System

This coordinates various laboratory tests and laboratory work on the basis of a precise job list prepared for various work sites and aids in preparation of certificates.

Program System for Material Management and General Ledger Bookkeeping

In addition to keeping analytical records on inventory movement in storerooms, this adds up use by various users and cost sites for a given accounting period according to various groupings and processes receipts in a form suiting general ledger bookkeeping at either accounting or balanced average prices.

In the case of accounting price records it gives information about accounting price changes by period if necessary. Inventory quantities can be queried at any time with screen or printed display. Naturally in addition to its function of recording and maintaining basic material data it can give effective aid to inventory activity performed in a given period and to working out inventory shortages and overages.

Developmental Ideas

As a first step we want to solve our cancer screening and maternity department processing, which are at separate locations, on one machine in the multi-terminal mode. The hardware realization of this is under way.

As a second step our goal is to set up a multi-terminal laboratory system, taking into consideration the size of our hospital and the volume of our laboratory tasks.

Our longer-range idea is to introduce a complete hospital information system, which will require acquisition of a new Proper-16/W machine (or machines) with purchased software (for example, KOMIR which is sold by SZKI).

In the area of material management also the multi-terminal solution seems to be the way of the future; with one terminal for each storeroom this would accelerate the flow of information and ensure daily maintenance of the related processing.

Propos-16 (3.0)

Disregarding minor errors the new operating system is very good. It is efficient, convenient and fast. There is more in it than there is in the documentation. We hope that with the newer operating system the documentation will be newer too, and more extensive. The PRINT function very usefully increases the performance of the machine. It is not a DOS deficiency, but certainly the inclusion of accented letters must be simplified.

EAST EUROPE/COMPUTERS

AGROSYS FOR AGRICULTURE

Budapest SZAMITASTECHNIKA in Hungarian No 11, Nov 85 p 9

[Article by Attila Kovacs: "AGROSYStem; Turnkey Systems From Zagyvarekas"]

[Text] A number of factors support the advantages of using turnkey computer systems in domestic agricultural and foodstuffs industry operations. Thus far no study course type computer technology training has been organized for agricultural and foodstuffs industry experts. Thus there are few experts capable of developing a system for the given tasks, selecting from existing systems with sufficient vision and security or seeing through and solving all the problems accompanying an application. The special conditions of agricultural operations represent another factor. In general the organizational units which are substantial from the viewpoint of generation of elemental data and use of information are located in large areas, separated from one another, and for the most part the computer equipment would have to be used under extreme operating conditions. As a result of these factors and as a result of the multi-layered production structure shot through with complex connections there is generally a need for well organized information which can be accessed quickly at the right spot, and for an analysis of the information received according to the factors given, in order to make production guidance decisions.

The AGROSYS Association

The AGROSYS Computer Technology Research, Development and Production Society, whose host is the Peace Agricultural Producer Cooperative in Zagyvarekas and a member of which is the MTA SZTAKI [Computer Technology and Automation Research Institute of the Hungarian Academy of Sciences], has developed a turnkey computer system for agricultural purposes with services which suit the situation deriving from the scattered nature of agriculture, the harsh conditions and the lack of experts. AGROSYStem implements an information system interdependent with complex enterprise guidance for agricultural and foodstuffs industry enterprises. Practically any of the domestic agricultural and foodstuffs industry operations could use it. It can be built up flexibly from a professional PC to a large system involving several local networks.

16 Bit System

The AGROSYStem ASY 8/16xx VME Z80 with double bus is a 16 bit microcomputer family made of modules developed jointly with MTA SZTAKI. It can be built up by modules from a single user computer to multiprocessor, multiuser systems. The minimal configuration is an 8 bit microprocessor with 64 K bytes operational memory; the maximal configuration is seven 16 bit microprocessors with 4 M bytes operational memory. Background storage varies between 1 M byte floppy disk storage and 200 M byte hard disk storage. The number of terminals which can be arranged in series can be 1-16.

The storage capacity of the ASY 8xx Z80 based 8 bit intelligent terminals making up a part of the system is 64 K bytes RAM and 8 K bytes EPROM, with 20 M bytes hard disk background storage, a COBUS local network coupler, RS 232 C and parallel interfaces. It is possible to build up a local network with a transmission speed of 1 M byte/s, and a maximum of 99 computers can be connected to the coaxial cable which can be a maximum of 1,000 meters long.

The 16 bit system elements work with an operating system compatible with UNIX and the 8 bit elements work with one compatible with CP/M. The network manager and the database management system are part of the basic software. The relational database management system makes possible management of distributed databases.

The turnkey user system can be regarded actually as a special purpose machine; that is, instead of installing a general purpose computer system the tasks or group of tasks determined for each work site can be performed there. With AGROSYStem the user can make immediate use of the dispersed system; that is, when the terminal is switched on the opening menu for the given work site appears automatically and the task to be performed can be chosen from the menu. If multiple users can work at one work site then a request for user identification precedes the menu.

A goal oriented development system facilitates the work of system developers; this includes ASYGEN and ASYLIB. With the aid of ASYGEN a complex data model for the subscriber and the system to be realized can be designed in a short time. The ASYLIB module library contains partial data models of the operational functions of the enterprise, element data unique to the processes, the system of connections and unique transactions.

With the AGROSYStem system one can realize operational production guidance and can perform planning and decision preparation functions for which it is useful to use computerized support in the case of the concrete enterprise. For foodstuffs industry enterprises and plants the tasks of the system can be tracking primary material supply, scheduling shipments, production, spreading out commodities, preventive maintenance, and the financial, billing and other information and accounting functions connected with these.

Services

The service group of the Zagyvarekas Cooperative services the systems placed out with users and the customer service section satisfies needs for expansion

and modification. Modifications or expansions meeting the needs can be performed without the change causing substantial down time for the user. Instruction consists of practicing use of the system; the user needs no special computer technology expertise or machine operator or programmer training. The experts of the cooperative survey the activity spheres at the user site, the amount of basic information, where it is generated, the physical distribution, the places where information is queried and used, etc. On the basis of this a plan for a complex system for the client enterprise is prepared, with an organizational proposal containing the necessary system elements, price information and installation schedule.

The first reference system is operating in the Peace Agricultural Producer Cooperative in Zagyvarekas. This extends to all the activity of the farm. An agreement was made at this year's National Agricultural and Food Industry Exhibition with the Grain and Industrial Plants Production System (GITR) according to which branch and accounting modules in the activity sphere of the GITR will be put into operation as a system service. System installations for 1986-87 are being prepared at a number of agricultural cooperatives and foodstuffs industry enterprises and at enterprises not belonging to the Ministry of Agriculture and Food.

The price of the smallest system element capable of independent operation is 350,000-500,000 forints, depending on the character of the tasks to be performed. A system is now being prepared the total price of which reaches several million forints.

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RAAB 84 MICROCOMPUTER

Budapest SZAMITASTECHNIKA in Hungarian No 11, Nov 85 p 12

[Article by -AK-: "Distributed Intelligence Systems Based on the RAAB 84"]

[Text] The RAAB 84, an 8 bit professional microcomputer developed by the CONTROLL Electronics Society in Budapest and manufactured in series by CONTROLL and the New Corn Ear Agricultural Producer Cooperative in Gyor, with MUSZI [Agricultural Business Organization Office] and SZAMALK [Computer Technology Applications Enterprise] participating in vending, has appeared at virtually every more important domestic exhibit and fair this year.

The RAAB 84 is a modular construction microcomputer family from the elements of which one can develop distributed intelligence, multiple work site systems. Any element of the family (a maximum of 254 machines) can be linked into a high speed (300 K bit/s) local network. The distributed intelligence can be realized optimally if one has has resource machines in the network (MC NET). In addition to connecting logical resources the MC NET makes it possible for programs written by a user to communicate with each other. This is of special significance when using distributed databases.

The Machine Family

The hardware elements of the computer are the following:

--the RAAB 84/A basic machine (Z80A processor, 64 K bytes RAM, 32 K bytes EPROM), with a maximum of four 1 M byte minifloppy drive units;

--the RAAB 84/W; the basic machine supplemented by two 10/19/27/40... etc. M byte Winchester disk units;

--the RAAB 84/T; an independent intelligent work site without background storage.

Other elements of the family are the RAAB 84/N local network coupler and the RAAB 84/M half inch magnetic tape drive interface (this provides an offline link with large computer systems). One can also connect a so-called streamer cassette peripheral. A printer of optional type can be connected to the machines. In addition to the standard, typewriter type keyboard one can find

numeric and programmable function keys (eight of them). One can switch between English and accented Hungarian (four) character sets with a pushbutton. As a result of the 3.5 MHz clock frequency the operating speed of the machine is great. The RAAB 84 can also handle a color screen (choice of 8 colors). The monochrome screen can be green (Orion) or amber (Philips).

Software Supply

The following are parts of the standard basic software: MC-DOS operating system (compatible with CP/M 2.2); MC-NET network control operating system; auxiliary routines; and BASIC interpreter. The operating system handles the disk background storage linearly, regardless of its capacity. The network control supports high speed communication between programs in an intelligent manner. The MC-DOS system handles any type of floppy disk, thus providing a sort of compatibility with other computers. The program languages which can be used are: BASIC, C, FORTRAN, FORTH, Pascal, COBOL, Assembler, PLIOPT, and PL/1. The following framework systems can be used: Dmon (compatible with dBase II, offered by SZAMALK for 60,000 forints), a text editor compatible with WordStar, various index sequential file handling and mini database management systems, and a screen oriented editing program for software development. Applications programs can be obtained for business organization, inventory management, bookkeeping and various agricultural themes. MUSZI offers the following programs in the producer cooperative sphere: general ledger bookkeeping, fixed assets, labor affairs and inventory management and operations analysis. The price of the programs, with installation, is about 150,000 forints each.

A RAAB 84/A with two floppy disk drives can be obtained for 340,000 forints. The price of a RAAB 84/W (two floppy disk units and one Winchester unit) is 780,000 forints. The price of an 84/T work site is 140,000 forints. All three prices are without printer. The network coupling unit costs 35,000 forints.

Where To Use It?

One of the first users was the Bakony Gaszt Enterprise where a RAAB system is used for the accounting tasks of the catering industry units. At the Gyor Distilling Industry Enterprise it is used for materials management tasks, at the Dialog subsidiary of the SZUV [Computer Technology and Business Organization Enterprise] in Gyor it is used to handle competitive bidding, at the TANEP of Gyor-Sopron County it is used for construction industry accounting, at the TESZOV of Tolna County it is used for agricultural accounting and in a number of producer cooperatives it is used for wage accounting and materials records. According to the plans network systems will be developed at the Skala-COOP (linked with a line code reader), at the MUSZI, the OTP [National Savings Bank], at the Bakony Gaszt and at provincial savings cooperatives (at more than 80 places).

There are reports that by the end of 1985 CONTROLL will complete development of a new member of the family, the RAAB 86, a 16 bit machine compatible with the IBM PC. This year the manufacturers plan to sell about 200-250 of the elements of the RAAB 84 computer family.

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SYSTEM FOR PREDICTING CROP DEVELOPMENT

Budapest SZAMITASTECHNIKA in Hungarian No 11, Nov 85 p 14

[Note in "News Mosaic, Monthly Chronicle" column]

[Text] Expected yields can now be predicted in the early developmental phase of crops. With the aid of a mathematical model worked out by Bulgarian and Soviet experts, uniform standards for scientific programming of yields have been developed. This collection of documents also contains a summary of experiences accumulated in the area of the intensification of agriculture in socialist countries. Taking into consideration the concrete natural conditions, the computer is capable, in minutes, of "playing" every process in the development of spring wheat, for example, from sowing to the ripening of the ears, and accordingly determining the conditions for maximum yields. It also determines the area of land, the machine systems and the work organization forms ensuring the greatest yield with the least expenditure.

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EAST EUROPE/COMPUTERS

VIDEOTON TV COMPUTER

Budapest SZAMITASTECHNIKA in Hungarian No 11, Nov 85 p 14

[Note in "News Mosaic, Monthly Chronicle" column]

[Text] The Videoton Computer Technology Factory is appearing with a new profile--a TV computer for educational purposes, but supplemented with background storage it will be suitable for simple business tasks as well. Manufacture of it began in the second half of the year at Tab and large series manufacture will begin in 1986. The strategic product of the Tab factory unit is the display, which they are developing in three categories. It is expected that in 1990 the people in Tab will be manufacturing several tens of thousands annually of the cheap and small to medium performance terminals and high performance (color and graphic) family. In the printer category the character drum printers will be replaced by character tape printers. In the slow printer category they have begun manufacture of matrix printers; further development is needed for these. There is a need at Tab for a complete reconstruction of the basic technology--assembly of printed circuits. It is expected that in the middle of the Seventh 5-Year Plan two-side assembly will replace one-side assembly. The present wave soldering must be replaced, switching to dual wave soldering and use of a water bath. Testing technology will be further developed also. In manufacturing the displays the factory unit must prepare for a qualitative change.

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EAST EUROPE/COMPUTERS

NEW COMPUTER, INFORMATICS INSTITUTE IN ROMANIA

Bratislava COMPUTERS AND ARTIFICIAL INTELLIGENCE in English No 1, 1986 p 28

[Text] The Central Institute for Management and Informatics, 8—10 Miciurin bvd., 71316 Bucharest 1 — Romania, and the Institute for Computing Techniques, 167 Calea Floreasca, 72321 Bucharest 2 — Romania, have joined. The new institute resulted from this junction is called

INSTITUTE OF SCIENTIFIC RESEARCH AND TECHNOLOGICAL ENGINEERING FOR COMPUTERS AND INFORMATICS

The institute has 3,000 research fellows and staff, working in 57 laboratories and departments. The main fields of the research and development activity are the following:

— design of new computers and peripherals;
— design of computer manufacturing technologies;
— development of systems software for new computers;
— new programming languages and their processors;
— CAD/CAM for various areas of industrial applications;
— robotics and industrial applications of robots;
— artificial intelligence research and expert systems for scientific and industrial applications;
— design and implementation of computer networks;
— application software for scientific, economic and social information processing;
— software for computer graphics and image processing;
— development of data base management systems;
— software for process control;
— research in software engineering;
— research, modelling, and software development for the National Information Processing System;
— education in computer science, computer programming, and information processing;
— the National Program Library;
— other activities related to computers and information processing

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EAST EUROPE/MICROELECTRONICS

ELECTRONICS INDUSTRY IN GERMAN DEMOCRATIC REPUBLIC

Warsaw ELEKTRONIKA in Polish No 8, Aug 85, p 26

[Article by Eng Günter Hoyer, Office of Trade Counsellor, Embassy of German Democratic Republic (Footnote) (Recent years have witnessed a dynamic growth of electronics in the GDR. Within the format of cooperation between the journal ELEKTRONIKA and the Office of Trade Counsellor (Department of Electronics at the embassy of the GDR), articles about selected achievements by our German neighbors will be published here), translated and elaborated by Dr Eng Andrzej Kobendza]

[Text] More than 100,000 workers in the German Democratic Republic are engaged in the production of microelectronic devices and components. Realization of goals over a period of several years has given rise to a high-productivity microelectronics industry.

These goals were:

- upgrading the qualifications of workers at various educational levels ranging from industrial to professional schools,
- long-term projects in scientific institutions and engineering research centers,
- wide-range investment,
- intensification of efforts in industries associated with electronics, especially in areas of chemistry, glass manufacture, and metallurgy.

At the present time the GDR is among those countries which have a microelectronics industry with its own material resources, research-and-development base, necessary equipment, and means of production.

The microelectronics industry in the GDR produces 4-bit, 8-bit, and 16-bit microprocessor systems. An 8-bit system consists of 4 modules containing about 50,000 transistors, while a 16-bit system contains over 150,000 of them.

The assortment of produced goods includes as typical items:

- a single-module microcalculator,
- electronic watches and time regulator modules,
- counter modules,
- programmable and erasable (8-kbit) fixed-word memories,
- static memories of RAM, ROM, PROM, and EPROM types,
- read-in/readout memories,
- control and remote-control modules,
- a broad range of bipolar digital and analog circuits.

In 1977 the Central Committee of the SED GDR ratified the "Microelectronics GDR" Program. In 1978 was established the "Mikroelektronik" combine, an umbrella organization of 23 enterprises employing 65,000 workers (among them 6,100 students).

The most important of these enterprises are:

° VEB Kombinat Mikroelektronik, Erfurt. Its main plant produces unipolar digital circuits and special-purpose measuring devices.
° VEB Halbleiterwerk, Frankfurt a. Oder. This semiconductor components manufacturing plant produces analog circuits and unipolar digital circuits.
° VEB Werk für Fernsehelektronik, Berlin. This plant produces color kinescopes, optoelectronic devices, and also sensing devices.
° VEB Mikroelektronik "Karl Liebknecht", Stahnsdorf. This plant produces semiconductor rectifiers, diodes, and transistors.
° VEB Mikroelektronik "Wilhelm Pieck" in Mühlhau produces low-power diodes, contactrons, and also pocket calculators.
° VEB Mikroelektronik "Anna Seghers" in Neuhaus produces masks and templates for microelectronic circuits, also low-power transistors.
° VEB Spurenmetall in Freiberg produces semiconductor materials.
° VEB Mikroelektronik "Friedrich Engels" in Ilmenau produces glass seal wires and casings.
° VEB Hochvakuum in Dresden produces special-purpose equipment.
° VEB Zentrum für Forschung and Technologie der Mikroelektronik, Dresden. This enterprise serves as technological research and development center, and also produces special-purpose equipment.
° VEB Uhrenwerke in Ruhla produce mechanical watches, quartz watches, and also special-purpose mechanisms.
° VEB Applikationszentrum Elektronische Bauelemente, Berlin. This enterprise, the application center for electronic devices and components with branches in all provincial capitals, serves as consultant to users on design of new instruments, appliances, and machines with modern electronic components.
° VEB Kombinat Elektronische Bauelemente, Teltow. This enterprise employs about 30,000 workers, concentrating on development and production of passive components such as capacitors, resistors, connectors, switches, and also printed-circuit boards.
° VEB Kombinat Keramische Werke, Hermsdorf. This plant produces not only passive components but also hybrid circuits on special ceramic and sintered-material substrates.

The "end products industry" makes extensive use of electronic components produced in the GDR. This ensures growth in the following areas:

- information technology,
- calculator and computer technology,
- machine and robot construction,
- automation,
- construction of manufacturing equipment,
- marine electronics,
- measurement and control technology,
- medical technology,
- radio engineering and television,
- other branches of the consumer goods industry.

With guaranteed access to an extensive own electronic components base, the producers in each branch of the industry operate under conditions favorable for unique achievements on an international scale.

The manufacturers of end products in the GDR use overwhelmingly (in terms of worth) components produced in the GDR. Considering the diversity and the quantities of required stock items, specialization within the CEMA format has proved to be highly advantageous. More than half of all types of components used in the GDR are imported from the USSR and other CEMA countries. The electronic components industry in the GDR is oriented toward far-reaching cooperation and specialization within the CEMA framework, also toward more extensive scientific and technical cooperation advantageous to all partners. Development of microelectronics in all CEMA countries may very well contribute to a better economic management of socialist nations and to closer ties between them.

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EAST EUROPE/SCIENTIFIC AND INDUSTRIAL POLICY

RECTOR OF GDANSK POLYTECHNIC DISCUSSES SCHOOL'S ACTIVITIES

Warsaw PRZEGLAD TECHNICZNY in Polish No 47, 24 Nov 85 pp 7-8

[Interview with Prof Eugeniusz Dembicki, rector of Gdansk Polytechnic, by Janusz Witkowski; date and place not specified]

[Text] Gdansk Polytechnic is observing the 40th anniversary of it scientific-teaching activity during the year of the Third Congress of Polish Science. What is the connection between this school and industry on the Coast? What can the Polytechnic boast of and how does it keep up with the science and engineering of the industrialized countries? How much interest is there today in scientific work and study? We asked these questions of Professor Dembicki.

[Question] Can Gdansk Polytechnic be considered to be a maritime school?

[Answer] That is probably obvious. After all, we are training cadres for the needs of the Coast economy. We are conducting scientific-research work on subjects connected with the industry of this region, and every institute of our school has some kind of connection with the maritime economy.

Naturally, the Shipping Institute leads here, but chemists, electricians, electronic technicians, production engineers, mechanics, hydraulic engineers, architects and scientists in the department of civil engineering, also have close ties with the industry and infrastructure of the Coast. In every field, dozens of significant scientific-research works can be mentioned.

[Question] And the most important, most valuable of these are...?

[Answer] There are a good many of them. Last year alone we submitted 116 applications on invention designs to the Patent Office. In 1984 the Polytechnic obtained 55 patents and utility models in Poland, and 19 abroad.

We have original works pertaining to the shipbuilding industry. For example, the half method of building ships, authored by Prof Jerzy Doerffer. And recently a test of a sensational--it turns out--ship-steering device was successful. The hydromechanical bases for the safety of ship stability were developed in the Shipping Institute and many studies and reports on the design and technology of shipbuilding were made. It was, after all, our professor, Adolf Polak, who designed the first ship steam engines, including a

steam engine used on the first Polish seagoing ship, the SS Soldek. The technique of side-launching ships, developed by Prof Aleksander Rylka, was found in a Polish Academy of Sciences survey to be one of the most distinguished scientific achievements. Professors Lech Kobylinski (specialist in ship theory), Jaroslaw Naleszkiewicz and Jozef Wieckowski, also made contributions to shipbuilding. They are world authorities in the field of the mechanics of ship structures.

[Question] Whose achievements do you believe have been the most valuable in the 40 years of the Polytechnic's existence?

[Answer] I have already mentioned some of them. Others worthy of mention include the originator of the pioneering concept of building cities and developing the coastal belt, Prof Wladyslaw Czerny; the distinguished architect who helped to rebuld the Gdansk Central City, Prof Marian Osinski; and the pre-war designer of port facilities, Prof Waclaw Tomaszewski.

Professors Kazimierz Kopecki, Robert Szewalski, Michal Broszko, Wladyslaw Krzyzanowski and Stanislaw Szpor made an enormous contribution to the development of Polish electricl, thermal and hydro power and high-tension technology. Our chemistry is responsible for the anticancer remedies of Prof Zygmunt Ledochowski, the antibiotics of Prof Edward Borowski, and the technology of edible fats of Prof Henryk Niewiadomski. The creator of the Polish school of concrete technology was Prof Bronislaw Bukowski, and Professors Waclaw Balcerski and Stanislaw Huckel were distinguished hydroengineers. The main designer of the first postwar successful Star-20 cargo plane was Prof Mieczyslaw Debicki. The list of distinguished scientists and their achievements goes on and on ...

[Question] Does Gdansk Polytechnic keep pace with world science and engineering?

[Answer] We can say very candidly that we try not to lag behind the important scientific-research centers in Europe. For many years we have been actively collaborating with scientists from countries which are highly developed in science and engineering. Contacts resulting from agreements on cooperation with centers in France, Great Britain, the FRG and Italy, head the list. We are developing cooperation with the Scandinavian countries and with the socialists states. For example, exchanges of experience with schools in the GDR, Bulgaria and Yugoslavia, are going well. Recently we signed an agreement with Xian University, in the People's Republic of China.

[Question] Has the crisis and the cooling of contacts of certain states with our country had an effect on this scientific cooperation?

[Answer] If we are speaking about collaboration with our scientists, in the last few years we have not seen an changes for the worse in our foreign contacts. Scientific cooperation in based primarily on mutual agreements and acquaintance between scientists--authorities in a given field, and this explains the lastingness of these ties. Actually, we meet with understanding of our economic situation and our partners try to facilitate exchange of

knowledge and experience. We continue to receive foreign periodicals and conference materials. We even pay for some foreign periodicals in zlotys...

[Question] Who benefits the most from these foreign contacts?

[Answer] I think that the benefits are two-sided, particularly if the cooperation goes on for many years. Our scientists have a foreign audience for their achievements, they take part in scientific work, and work towards higher degrees in their professions. On the other hand, the scientists who are guests in our country do not come to Poland as tourists. We have plenty to be proud about. Naturally, we cannot compete with foreign centers from the standpoint of newness of research apparatus or laboratory equipment. However, the scientific level of the Polytechnic staff allows us to conduct joint research on a partnership basis. For example, our joint research with the French on civil engineering. geological engineering, electrical energy, electronics and chemistry. In the area of maritime economy, our cooperation with schools in the USSR and FRG is going very well. In the last 10 years the Shipping Institute and the Electrical Department have developed broad contacts with corresponding institutes in Leningrad.

[Question] How does this cooperation look from the practical standpoint?

[Answer] Our modeling studies are quite well developed, thus tests are being made. However, results are calculated and processed in computer centers abroad. Another example: We undertake joint research on a subject, dividing it into parts. After each part is finished, we discuss the individual parts, and then publish joint papers. We also invite scientists from abroad to scientific conferences. Our employees are lecturers in foreign colleges, the younger ones do their research there, get their training there...

[Question] Is the treatment by some scientists of foreign travel as an earnings opportunity compatible with professional ethics?

[Answer] It is important to us that collaboration bring benefits to Polish science and that it is to the advantage of our school. That is why we sometimes limit the contract period of our scientists, particularly those connected with stays in Third World countries. After several years of work in developing countries our distinguished scientist often loses contact with science, with the scientific community. This is a loss for both the scientist and the school. There are examples in Gdansk Polytechnic which confirm this opinion. We have decided, therefore, that the maximum contract stay should not exceed 4 years. After all, it is better to open up doctoral or postgraduate studies in our own school for young people from the developing countries.

Similarly, we cannot permit excessively long training in highly industrialized countries. The knowledge and experience which has been obtained should be reflected in scientific-research work done in the home institute and not in a foreign center.

[Question] Several years ago the number of people qualifying for assistant professorships in Poland dropped. How do you now assess the scientific level at Gdansk Polytechnic?

[Answer] That which took place at the beginning of the present decade--the lack of interest in scientific work--had a deeper underlying basis, a sociopolitical basis. In any case, it was not just among scientists that a decline in professional activity was observed. A certain renewal of interest in science has recently been noted. At Gdansk Polytechnic the number of doctoral and assistant professorship theses and dissertations has risen. Undoubtedly the law limiting the time for qualification as adjunct professor to 9 years has had an influence on this renewal of interest. Furthermore, conditions have been created which make it easier for outstanding individuals to advance in science. These include scholarships, sabbaticals, reduction of teaching load, and assignments abroad.

[Question] And what happens to those who are less outstanding?

[Answer] Scientific work cannot be looked upon as a sinecure or a front behind which one can practice so-called science without producing any significant research results. We find it totally incomprehensible that a person who has worked for many years in a school has made no contribution to science, has published nothing of a scientific nature, or has achieved nothing of a design or technological nature. We must demand a certain internal discipline starting with the very young workers. They must have the indispensable predisposition for scientific-research, design or technological work. The selection process for scientists, i.e., trainees and assistants, should be very rigid.

[Question] Do you do this at your school?

[Answer] We are constantly taking on a new and young cadre. We accept trainees from among graduates, even for a partial teaching load, so as to have "something" from which to make a selection. But a school cannot be a repository for those who are just average. An assistant has 8 years in which to qualify for a doctorate. That is long. In other countries, e.g., in the FRG, a doctorate must be obtained within 5 years. This is a sufficient period in which to convince oneself and others that there is the necessary predisposition.

[Question] What opportunities do graduating students, those who intend to remain at the school, have to learn about engineering advancements and to put into practice that which they have learned?

[Answer] Before being promoted to adjunct and docent, the employee must undergo industrial training. We will comply with this. Science must be utilized in industry, otherwise it becomes art for art's sake. In order to become acquainted with the problems and the technical state of industry, one must work in it.

[Question] Do you think that an enterprise which is struggling to fulfill plans and is occupied with its immediate operatons is concerned about contacts with scientists?

[Answer] It should also lie in the interest of industry to make better use of science. In order to obtain better results in the future, industry must first become more innovative.

[Question] Your graduates work in industry, and look upon scientific-research institutes in many different ways...

[Answer] I believe that the young engineering cadre, if it were not restrained in various ways, would know how to effectively bring innovation to industry.

[Question] What kind of engineers does your Polytechnic train?

[Answer] We are set up to train engineers who are well-prepared in theory, but are oriented towards industrial and executory practice. In our teaching work we place emphasis on development of creative independence in design and technology. An engineer must not only know a great deal, he must know how to apply that knowledge in practice.

[Question] Student practice is supposed to acquaint the future engineer with his job and its associated problems. Thus far, this has only been a wish.

[Answer] Unfortunately, experience with vacation practice differs. But this is not a matter of the school alone. Industry is experiencing a crisis. The plant managements are not generally interested in improving the forms of student practice. Fortunately, there are exceptions. Our cooperation with shipyards is good. Students in the machinery, ship and mechanical-processing departments first go through a cycle of professional orientation and then go to work with a team where they have an opportunity to familiarize themselves with engineering on a good level. Student practice in other departments is not that good.

[Question] What is the present interest in polytechnic studies?

[Answer] In the last 5 years we have seen a drop in the number of candidates for our school (from 1,600 to 1,250). But we also have fewer spaces. On an average, 1.2 to 3.8 qualified candidates compete for the first study year. The number of persons graduating on time is also disturbingly low. The young people are in no hurry to take on a responsible job. For example, in the Machinery Construction Department this year only 36 percent of the graduates completed their diploma work on time. And there are departments in which only a few persons submitted their final work within the normal prescribed time. This situation must be changed as soon as possible. As I said, the Polytechnic cannot be a repository either for mediocre scientists or for unconcerned students who do not treat their obligations seriously.

[Question] Is this "severe course of action" the consequence of the application of the law on higher schooling?

[Answer] What we are doing and what we intend to do stems primarily from the belief that everyone should find his place in accordance with his predispositions and willingness to fulfill the duties that he has assumed.

END

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